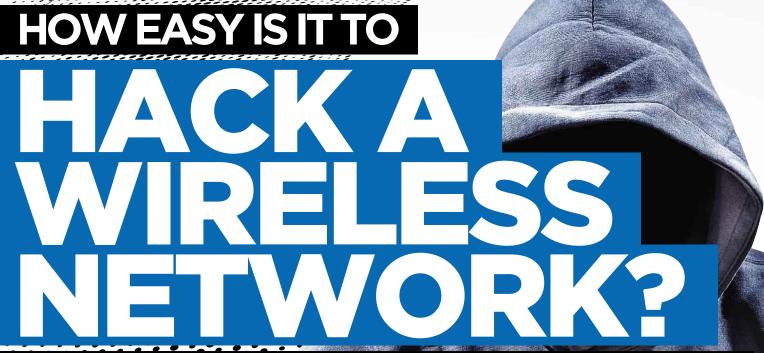
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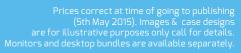
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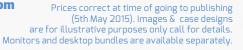
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## **08** Wi-fi Hacking

Remember when going online meant you had to connect a modem to your phone line? Back then, the idea of wireless connectivity seemed like little more than a dream, but now it's everywhere. Is it secure, though? And if it's not, who could be trespassing on your digital turf? David Crookes tells you what you need to know to remain safe

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# How Easy Is It To Hack A Wireless Network?

With wireless networks commonplace, are we becoming complacent?

David Crookes looks at how safe your network really is

econds. Mere seconds. That is the figure many an expert will tell you measures the time it takes for a hacker to infiltrate a home network. It may sound alarmist, it may be designed to make you sit up and listen, but a study five years ago showed that half of home wi-fi networks could be hacked in less than five seconds, and the situation does not appear to have become better since.

With determination, it wouldn't take long for anyone to work out how to get into a network. A report on the website **securityaffairs.co** showed researcher Dominique Bongard finding a way to attack wireless routers that had a poorly implemented version of Wi-fi Protected Setup (WPS). It took him just one second using offline calculations. To aid would-be hackers, there are websites that promise to help you crack wi-fi passwords in two minutes. There are many others that detail popular wireless hacking tools.

But then we've long known that wireless networks are vulnerable to attack. It may be that your neighbour is savvy enough to piggy back on your wi-fi, slowing down your access and benefitting from a freebie. This is bad enough, but there would be no telling what he or she is using your network for: is he or she downloading illegal items? Is he or she using it to hack into GCHQ?

Sure, we're always wary of people hacking into public wi-fi (in January this year, even a seven-year-old was able to hack into a public wi-fi system in under 11 minutes, and in-flight wi-fi is assumed to be at risk from rogues seeking to control the aircraft system), but home wi-fi is yours; it's personal and it arguably carries a greater personal risk. Stats in America show four out of five internet-connected homes are at risk of attack through a wireless router, and it would not be surprising to see similar figures in the UK.

## We've long known that wireless networks are vulnerable to attack

"Don't be fooled by someone telling you your data is secure. If you are accessing the system wirelessly, it is never secure," says hacker Matthew Beddoes, who was caught stealing carbon credits from the United Nations to sell on, earning him a three-year jail sentence. Invited to talk to businesses in the North West of England last year by the Aintree-based Stack Group, the man who goes by the pseudonym the Black Dragon demonstrated



how a £30 Raspberry Pi could be used to bypass security features. "All this code is free and publicly available."

## **Explaining Wireless Networks**

Wireless networks are based on IEEE 802.11 standards as defined by the Institute of Electrical and Electronics Engineers. There are two security protocols: WEP and WPA, the former deemed weak and having been surpassed by the latter, which is now on version two, WPA2. For hackers to gain access to a network, he or she needs to smash through this protocol. With WPA and WPA2 this can only be done through brute force, either by gaining an idea of how the network is being used or using specific software and tools to do the job. Poor encryption and sloppy configuration are the two key mistakes that allow hackers through.

## A seven-year-old was able to hack into a public wi-fi system in under 11 minutes

And get through they do, for money is a motivating factor for hackers. Being able to find holes in wireless networks can be lucrative, and coders who provide software that enables cracks to be prised open are often paid handsomely for their efforts. Black hat hackers – those who prey on networks for their own negative ends – only see networks as a challenge, and they are determined enough to win. White hat hackers seek to help defend us from these problems by finding vulnerabilities first, so are therefore always playing a game of cat and mouse.

What makes the problem worse is that we are relying on wireless networks more than ever before, thanks to the Internet of Things becoming a reality in British homes. The



## **Getting Hacked On A Public Wi-fi Network**

There are some things to watch out for when accessing the web on your travels.

## 1. Note the name of the connection

You may think that you're logging into Starbucks' wi-fi, but what's that other similar sounding provider? Should you be choosing StarbucksWiFi or WiFiStarbucks? If in doubt, you should always ask the provider for the exact identifier before you connect. Getting the wrong one means you could be connecting to a rogue hotspot, and that may route your sensitive information to a hacker's server.

## 2. Turn sharing off

One of the first things to do when you're hooking up to public wi-fi is turn sharing off. In Windows, go to Network and Internet > Network and Sharing Center and select Homegroup and Sharing Options > Change Advanced Sharing Settings. Choose the public profile and ensure network discovery, file and printer sharing and public folder sharing are turned off. On a Mac, go to System Preferences > Sharing and untick everything.

## 3. Activate the firewall

Firewalls control the incoming and outgoing network traffic, forming an effective barrier. Go to the Control Panel on your PC and turn the firewall on. Using a Mac? Go to System Preferences > Security & Privacy, select Firewall, click the padlock and click Turn On Firewall.

## 4. Use a virtual private network

VPNs guarantee to encrypt and secure data, so if a public wireless network is hacked, your data cannot be intercepted. If you're restricting your web use to a web browser, CyberGhost has a free proxy for web traffic at www.cyberghostvpn.com/en\_us/proxy.

## 5. Just use your phone

A 3G or 4G connection is more secure than public wi-fi, and data plans are getting better again so make use of it. You can tether laptops and tablets to your phone. Check out your provider's web pages to find out how to do this.

wi-fi network is the thread that ties these digital devices together in the home, and yet, according to security companies such as Avast, very little attention has been paid to securing it. Wireless routers are fast becoming a lucrative target for hackers – exposing financial information, passwords, private photos and even browsing history – and that is because wireless traffic is open to eavesdropping.

Even when that traffic is encrypted, hackers are able to crack it open and pluck whatever information they need out of the airwaves. Whether they are taking those passwords or causing problems with your emails, the issues hacking causes can be keenly felt. Another problem is that encryption, while improved, is seldom strong enough to offer perfect protection. The good news, though, is hackers tend to go for the least protected networks. So let's look at how easy we may inadvertently be making it.

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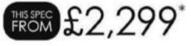


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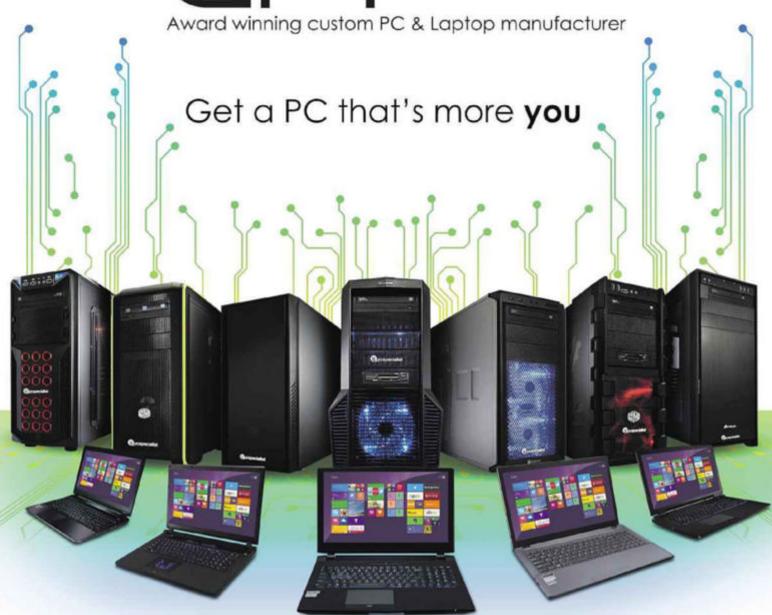
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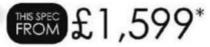
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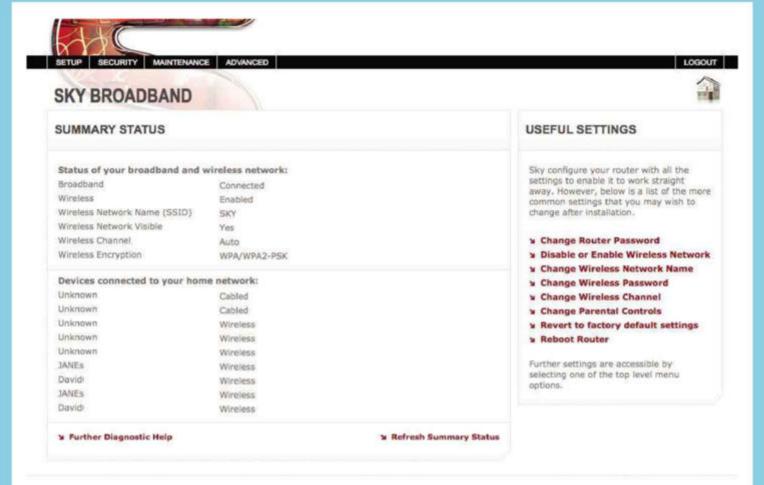
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## Performing A Drive-By

There was a time when some hackers would grab a laptop, drive down a street and pick up on insecure wi-fi signals beaming out of people's homes. There are also occasions when a neighbour will look for available wi-fi and hope to piggyback on it. This is known as snarfing, and it can be more than just a nuisance, as viruses are installed on systems and spam is sent.

The ease with which people can do this is due to a great many networks being like eggs. They have a hard interior, but crack them and you'll find they're soft inside. A hacker will therefore do all they can to get through that protective layer, looking for vulnerabilities and going after those networks that are easier to get into. Someone attempting to penetrate a large network such as a company will seek host names, network addresses ranges, exposed hosts, information about operating systems and any software on the machines that may be exposed.

In a home, an attacker will seek similar vulnerabilities, and with so many devices now hooked into a network, there are a greater number of entry points. A smart TV can be used to gain access, and it may have fewer network restrictions. But the main entry point is an unsecured user. Using software such as Aircrack-ng in combination with a wireless card, hackers are able to discover passwords, having captured the handshake between the computer and the router. Aircrack-ng even offers step-by-step instructions.

It used to be that software was needed to scan for available wi-fi networks, but this is built into computers these days. When

you look to connect to a wireless network, you are given a list, and that has made it even easier for hackers to identify possible networks to break into. The hackers tend to work together, posting information online to help them to complete their work. There are password lists available, for instance, which can be used to force their way into a network; the easier the password, the quicker the process will be. And so many people use the simplest of passwords or don't even bother to change the one the router came with.

"Unsecured routers create an easy entry point for hackers

## Technology cannot save most of us from social engineering hacks

to attack millions of American home networks," says Vince Steckler, chief executive officer of Avast. "If a router is not properly secured, cybercriminals can easily gain access." Too many routers are poorly protected by default or common, easily hacked password combinations such as admin/admin or admin/password, or even admin/<no-password>. And for those who change them, the most typical passwords are often too easily guessed.

The problem is that the software used for these cracks is so easily available. WEPCrack is an open-source tool, which lets people break into 802.11 WEP secret keys. AirSnort bills itself as a wireless LAN encryption key recovery tool. It operates by passively monitoring transmissions, computing the encryption key when enough packets have been gathered. KisMAC for Mac OSX and Kismet for Linux need advanced knowledge, but they will help to crack WEP and WPA keys by brute force, exploiting flaws including weak scheduling and badly generated keys.

There are even online tools. CloudCracker is aimed at penetration testers and network auditors who are looking to check the security of WPA-protected wireless networks, crack password hashes or break document encryption. Thankfully for those who use this particular service there is a charge, so a money trail is left. Access a secured network without authorisation using CloudCracker and a hacker will likely fall foul of the law. Use it to test your own vulnerabilities, though, and it could be money worth spending.

But with all this in mind, you should be protecting your wireless router. In order to access it, you'll need to enter your IP address into a web browser, which you'll be able to typically find on the back of the device. Enter the default password (check your internet service provider for the details. For Sky, for instance, you would enter admin/sky), and then make sure you alter it so something that is far less easy to crack.

While you have the router details open, though, you should also look at the level of encryption you have for the data transmitted from your computer to the router. It is very unlikely that it will be set to the dated encryption format WEP, but make sure that it's WPA2, and if it isn't available, update the firmware for your router so that it supports it. WPA2 security with AES/ CCMP encryption gives you a better chance of beating off hackers, but it's not crack proof. Going back to 2010, ElcomSoft, a member of the Russian Cryptology Association, developed a product that combined graphics cards from Nvidia and ATI to accelerate the recovery of WPA2 encryption passwords.



## **Protecting Your Home Wireless Network**

How to keep your network as safe as possible.

## 1. Encrypt the wireless network

Avoid using WEP. It has vulnerabilities, and it is very easy to hack. There are loads of tutorials online that show people how to do this with an app and a handful of step-by-steps. Instead, change the network settings so you're using WPA/WPA2.

## 2. Change the router password

So many people do not bother to do this, and yet it is a major vulnerability. Many ISPs reveal the default login and password online, so you can't really get much more open. Make sure you log in and change the password to something that is very difficult to guess – the longer the better.

## 3. Enable the firewall

A router has a firewall, but it's not always turned on. You need to check it and turn it on so it blocks unsolicited incoming traffic and protects the network from the 'wild' internet. Some routers will also allow the blocking of some outgoing traffic.

## 4. Enable MAC address filtering

Every wireless networking card has a MAC code. By enabling filtering, that address is registered to your networked devices and only they will be able to connect to the network. It's not foolproof, since MAC addresses can be cloned, but as backup to WPA2 encryption it will make your network more secure.

## 5. Change the SSID name

The SSID is the name that is given to your network by a provider and the one you look for when you're connecting. Many of them identify the network, so you'll see references to EE or Sky, for instance. By altering the name, you can mask this extra information, so knowledgable hackers have to work harder to figure who provides your internet.

## 6. Do not allow remote access

There's a chance you're not going to need remote access to your router, so if this is the case then remove the ability. It's usually disabled by default, so leave it that way if it is. Sure, you'll need a LAN cable plugged into your router if you want to make changes, but it will disable the opportunity for wireless hacking.

Fast forward to today, and you're able to use the likes of Reaver, which "implements a brute force attack against WPS registrar PINS in order to recover WPA/WPA2 passphrases". It says it has been designed to be a robust and practical attack against WPS, and it has been tested against a wide variety of access points and WPS implementations. What's more, it will recover passphrases within four to ten hours. Patience is required, for sure, but it's possible. The software works by testing the connection between a wi-fi device and a router with Wi-fi Protected Setup turned on. It goes without saying that to protect yourself from such hacks to some degree, you need to turn WPS off.

"Today's router security situation is very reminiscent of PCs in the 1990s, with lax attitudes towards security combined with new vulnerabilities being discovered every day creating an easily exploitable environment," says Steckler. "The main difference is people have much more personal information stored on their devices today than they did back then."

## Router To Nowhere

It doesn't help that more than 75% of all routers that are provided to customers by ISPs contain software or firmware easily exploited by hackers. Independent Security Evaluators researchers said they discovered "critical security vulnerabilities" in numerous small office/home office routers and wireless access points. "These vulnerabilities allow a remote attacker to take full control of the router's configuration settings; some allow a local attacker to bypass authentication directly and take control. This control allows an attacker to intercept and modify network traffic as it enters and leaves the network," the report said. It is no surprise given that companies want to provide as cheap a device as possible to customers.

Still, Steckler says one of the biggest risks on any wi-fi network is DNS hijacking. This is when hackers exploit vulnerabilities in a user's unprotected router and play around with the Domain Name Service so it diverts people from bona fide websites to malicious ones. It allows for the harvesting of credentials including logins. Because the user has been going to a specific site and since it looks identical to the proper one, they suspect nothing and they potentially lose everything.

These so called man-in-the-middle attacks are not to be taken lightly, but you can protect yourself from them. Routers use DNS servers that are automatically acquired from an internet provider, so if you fear the settings have been altered you can opt to change them. You can go to the Network and Sharing Center, select Change Adapter Settings, choose the connection you want to alter and then click 'Internet Protocol Version (TCP/IPv4)' or 'Internet Protocol Version (TCP/IPv4)'



## **Hacking In Figures**

- 90% of internet hackers are amateurs.
- 9.9% are for hire.
- 0.1% are world class.

Source: Crowd Control HQ

IPv6)'. You can choose the Google DNS using the settings 8.8.8.8 or 8.8.4.4, or for Ipv6 2001:4860:4860::8888 or 2001:4860:4860::8844.

But even technology cannot save most of us from social engineering hacks. In March at CeBIT, ex-hacker Kevin Mitnick used USB drives, wi-fi access points, PDF files and cloned wireless keycards, and he was able to gain control of targeted machines. In his hacking career, his chosen method was to sift through the usernames and passwords thrown out by companies, and he was able to seize control of networks. Antivirus software is no match for such methods.

There are more ingenious methods and lengths that hackers will go to, though. In August last year, Gene Bransfield in Virginia hacked into the networks of his neighbours by fitting his pet cat, Coco, with a wi-fi sniffing device. He called the animal his WarKitteh and allowed it to exploit the networks of 23 homes, a third of which used WEP. The cost of the device was just £60. It's not much of a leap to suppose that similar technology could be used on board drones by determined hackers.

When you then go on to read reports of vulnerabilities in software that controls wireless networking chipsets made by Realteck Semiconductor, which is said to allow attackers to compromise home routers, you realise that you can be powerless. The chips are inside models made by Netgear, D-Link and Trendnet. Hackers are able to exploit the vulnerability and gain administrative access to a router. They could infect devices on a wi-fi network. The advice has been to keep router's firmware current but that is essential to do. But as one commentator pointed out, even if RealTek came up with a patch, it would not be implemented on all affected devices. Many of them are no longer supported by their manufacturers.

One thing you should avoid, though, is trying to exploit vulnerabilities yourself. Computer hacking is illegal in the UK, and you will face a possible prison sentence. The Communications Act 2003 says a "person who (a) dishonestly obtains an electronic communications service, and (b) does so with intent to avoid payment of a charge applicable to the provision of that service, is guilty of an offence". So if someone breaks into a wireless network that they should be paying for or if they break into your wireless network and avoid charges, that could potentially get them into trouble, and there have been cases where perpetrators have been caught and taken to court. This is not the case the world over: in the Netherlands, a court ruled that wi-fi hackers could not be prosecuted for breaching router security, because the majority of hackers who do this are not gaining access to the computer, only the connection. But it is certainly how it works in the UK, so please do be aware of that.

What we've done here is show that there are tools available that allow ordinary people to hack. And by remembering that hackers are not always anti-social types locked away in darkened rooms, you should be better prepared to head them off. As wireless networks become commonplace in our homes, taking small steps to protect your wireless router today will put you in a far stronger position. mm





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## Wear It Out

## Ian McGurren spends a week with Android Wear strapped to his arm

atches eh? They're rubbish! Just telling the time and the date, maybe an alarm if you're lucky, but do they have any apps? Or a high-resolution screen? No, so by that extension they deserve to be cast from the hi-tech futureworld of 2015 like vinyl records, newspapers and the Teasmade. Thankfully, though, both Google and Apple have seen fit to bring this relic of technology into the 21st century, so what happens when the crusty old, precision-engineered wristwatch of the past meets bang-up-to-date, bleeding-edge technology?

The watch is something of a technological enigma in this modern world. Barely unchanged for centuries, bar the digital watch's introduction in the early 1970s, the device is a very good example of functional technology that has long since perfected itself and reached its engineering peak. In terms of its main function, a Swatch is as good as a Patek Philippe, though the vast difference in price will afford you a bump in

## The watch is something of a technological enigma in this modern world

handmade precision, complications and bragging rights. The point, though, is that neither owner would have lamented any lack of features, as both would have fulfilled the purpose of their purchase: telling the wearer the time of day.

This is the dilemma many have with smartwatches: do they really need to be smart? What does a smartwatch offer that a regular, cheaper watch cannot? After all, both tell the time, and that's pretty much a watch's remit. Seeing the various

## ANDROID WEAR



operating system brother, Wear is available on a selection of devices. Most cost around the £200 mark, with two coming out as the front runners – Motorola's Moto 360 and the device I used, the LG G Watch R. Why the G Watch R specifically? Easy: it's the only Android Wear device to feature an OLED screen. Not only does this extend the battery life by lighting only the parts of the screen in use at that time, but it's able to offer a true low-

The G Watch R is technologically superb but uninspiringly designed, unless you like your watches manly and made of chunky plastic

power mode, meaning the G Watch R can show a watch face at all times (like a real watch does) at little cost to the battery.

## The Hardware

So how is the actual watch itself? Well, on the plus side, it looks and feels just like a watch and not like some technological curio strapped to your arm. On the negative side, though, while it does feel like a watch, it doesn't feel like a £200 watch or look like one for that matter. Don't get me wrong, it's well made and of good quality, but were it not smart, you'd hesitate to pay more than £50 for it. This isn't helped by the uninspiring leather strap, though LG claims any 22mm watch strap will work with it. The watch chap at the local market

adverts for the Apple Watch and the Android Wear devices, it's clear that the manufacturers are keen to promote the smartwatch as less of a watch per se, and more as a second screen for your mobile device that happens to be on your wrist. In fact, calling it a watch may only cause to distract buyers from its real purpose.

I'm in the middle ground here. There are some stunning traditional analogue watches that are mechanical works of art, but I'm also from the era of the Casio calculator watch and digital watches with vacuum fluorescent displays, so a timepiece with fancy tricks appeals to me. But beyond having a shiny new gadget, can I justify a smartwatch to myself? I spent a week with an Android Wear device – the LG G Watch R – in an effort to understand just what it can offer me.

## Which Watch?

Unlike Apple Watch, Android Wear is not a device but instead is a subset of the Android OS tailored for the smaller interface needed for watches. Therefore, in common with its bigger



▲ LG's G Watch R is arguably the best Android Wear device



Pujie Black faces: "Pujie Black is a superb customisable face app that shows off Wear"

wasn't as convinced, though. Bottom line here – the G Watch R is technologically superb but uninspiringly designed, unless you like your watches manly and made of chunky plastic. On my not-quite-as-manly as-I'd-like wrist, it didn't look as good as my rather more fetching Skagen timepiece.

Looking past its watch attributes to the technology, and things perk up a bit. Standing out is the round OLED screen, as in round like a watch, not square like other smartwatches . Stylistically it's a hit, though practically it isn't quite as effective. The display is curtailed, and those apps that use the full square screen are cut off, not 'rounded' off. But, conversely, the rounded watch faces are far more effective on this screen, especially those that offer the low-power Always-On alternative time face. Coupled with the sharp 320 x 320 screen, this is the best interpretation of Android Wear so far.

## Day 1 - About time

Popping the G Watch R from its very watch-like box, you get the device itself, along with a USB charger and the charging dock. It's not the dock itself that's the first bone of contention, the watch sits in it fine and doesn't move, but it's that it realistically restricts any straps other than buckled ones being used. An elasticated metal or bracelet style strap may look great, but you'll find charging a massive pain.

It stands to reason that Android Wear requires the use of an Android phone in tandem to do anything beyond telling the time, and the newer, the better. For my week, I had Google's own Nexus 6 to handle these duties, and it's certainly a device that could do with a smaller alternative method of use. What's more, it's Google through and through, so no blaming glitches on proprietary hardware or quirks of different software – from a Google Wear watch to a Google Wear app on a Google Experience handset, the chain is Google all the way.

Joining the watch to the phone is as simple as downloading the Android Wear app and pairing the watch to the phone. For me, the process was straightforward and quick, though others have found the app doesn't work so well for them, and that's a sticking point to the whole setup.

The setting up of the watch could be done from both the app and the watch itself. On the watch this is accessed by holding on the screen until the menu system appears, then flicking up or down. It works fine, though better for quick one-off changes. Any more in depth changes are better done on the phone itself.

## Day 2 - Face off

If there's one thing that'll keep you tinkering with your watch in the first week, its the multitude of watch faces available. Those for the square-faced watches tend to be creative or look like reasonable copies of real watches, but it's on the round-faced watches like the G Watch R that they take on a whole new look. From Rolex to Casio G-Shocks, Mickey Mouse to Swatch, all are available and many look impressive. The most effective facsimiles are those less ornate, such as the classic digital LCD and VFD style from the 70s and 80s, simple designs that complement the hardware on which they reside. The more extravagant end of the market still translates pretty well, but while the watch face can look like a TAG Heuer, the actual watch is still black plastic.

Aping of other watches isn't where the true creativity lies, however. The real innovation is in those faces that cannot be

## 66 If there's one thing that'll keep you tinkering with your watch in the first week, its the multitude of watch faces available 99

achieved on traditional analogue or digital watches, including those customisable on the fly. Of these, the standout example is the oddly named Pujie Black, a face with a clutch of configurable parts that allows the user to easily build a personal watch face. It's simple to make them but vast enough to have a wide variety of modern-looking designs. There's even a repository of faces made by others if the imagination runs dry. Topping it off, not only can you build the regular face, but also the Always On face too, taking full advantage of the G Watch R's screen. After tiring of trying out many different copy faces, it was Pujie Black that I found myself returning to, eventually settling on a face that gave me the information I most wanted.



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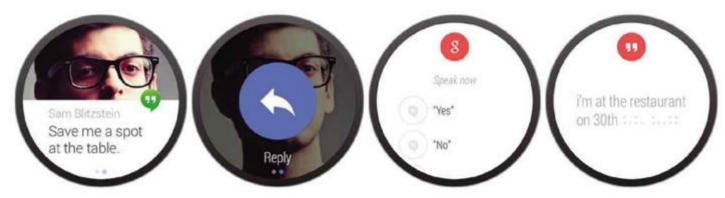
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▲ Wear's message reply is good, as long as you keep it short

## Day 3 - Wake up

Like any other Android Wear device, the G Watch R can't really do much without being attached to an Android phone, beyond a few basic watch-like functions. This is a shame, because I found my watch disconnected from the Nexus on more than one occasion. This wouldn't be so bad if it had independent use, but given the symbiotic relationship requires a connection to make its smart functions work, it meant I couldn't safely rely on the watch to be my sole source of notifications. Reconnecting the device meant rebooting the watch or even removing and adding the device to the Android Wear app on the Nexus, both of which were a considerable pain, especially as there seemed to be no reason for why the device would lose connection, even in the midst of updating watch faces. Sometimes this could possibly be blamed on the distance from the Nexus, but even then it would remain disconnected until rebooted / re-added, even when placed next to the device again.

## I elicited a few odd looks talking into a watch in the middle of Marks and Spencer

As well as loss of notifications, those of you who use Google Now will know that the service relies on a web connection for the voice recognition to work its wonders. As the watch gets its connection to the internet via its ad-hoc connection to the host phone, not via wi-fi, it means that no connection means no replies, searches, navigation and more. This is annoying enough when you see the little cloud with a line through it pop up, but it's even more so when mid-task it just seems to hang without any notification at all, and only checking your phone's Wear app gives a clue that it has again become disconnected. For all its positives, this was my biggest source of frustration, and its frequency suggested a distinctive whiff of 'beta' about it.

## Day 4 - Out And About

It's all well and good playing about with the watch to my heart's content, but to really see what it can do, it's better to go and find out if Android Wear can improve day-to-day life. It wasn't a particularly warm day, so a heavy coat was called for, where my Nexus 6 will be somewhat deeply buried, and it's here that the first real advantage of the watch makes itself known: notifications on your wrist. The walk into town was punctuated by a few notifications from emails, text messages and WhatsApp, all of which partially popped up on the watch's screen. From here they could be swept up to read and / or to the side to ignore or reply. This was very helpful, saving rooting around in the pocket for a big phone, especially when a majority of the messages didn't warrant an immediate response.

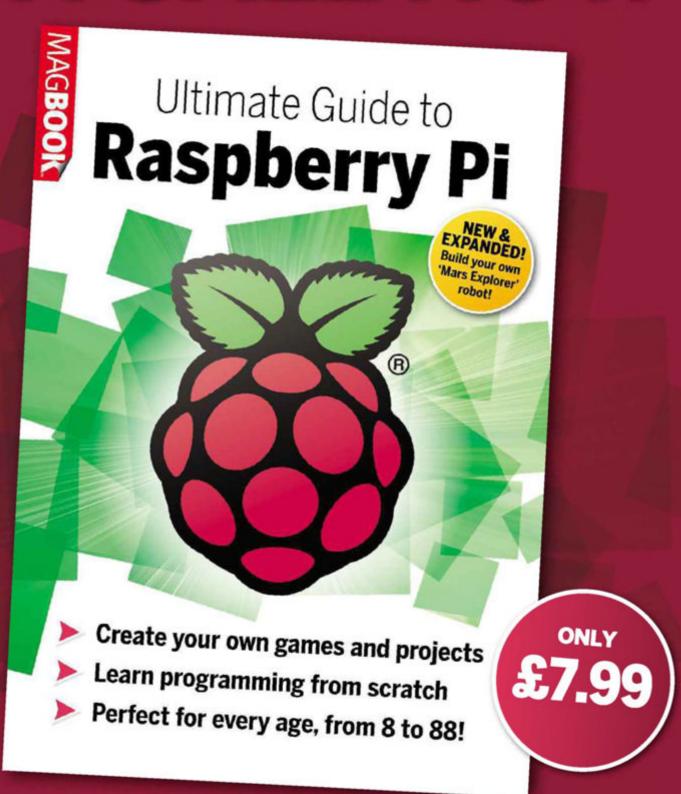
For those that did, however, it was an ideal opportunity to try out the reply function. Being a small device, having a keyboard is impractical, so the only form of input available is voice activated, much like the voice input of the Google Now service. Here it's a case of swiping to the 'reply?' screen and dictating the reply. Simple in concept, but in practice it was quite hit and miss. Where replies were able to be kept to a single sentence, the system worked quite well, as long as you were able to speak clearly and didn't require punctuation or capitalisation (giving them away to recipients). If you want any more than one sentence, though, tough, because a few seconds pause constitutes the end of the message. Any mistakes also required starting again, plus I elicited a few odd looks talking into a watch in the middle of Marks & Spencer...

## Day 5 - Appy Days

It's not mobile if it doesn't have apps, and the Android Wear platform is no exception. There are apps for the device itself, as well as regular phone apps that also add additional features to Wear watches. That said, there's not a huge amount just yet, though the release of the Apple Watch will likely lead to an upturn in these kinds of apps. Most on Wear at present are basic and reminded me very much of the Java MIDP apps on phones of the early 2000s. Apps, such as Twitter, had the feel of an RSS feed on a Nokia device; games were more a proof of concept than a serious distraction; and you'd expect a keyboard-free browser on a 320 x 320 circular screen to be as good as it sounds.

That's not to say there weren't some good apps, though these tended to be Google's own factory apps. Google Now is as good as it is on your phone – that is to say, exactly the same. Fitness, while not quite as fleshed out as Apple Health, is pretty accurate. The phone app itself isn't that great, though, with distance measured in steps rather than miles or km. The remote for Play music wasn't too bad either, if you were already playing music that is, otherwise you get the first playlist and no easy way to navigate your library.

## ONSALENOW



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▲ The web browser on Wear is about as practical as it is on a Nokia 3330

## Day 6 - Other Reactions

I'd had the G Watch R for a few days now, so it was time to see what others thought of it. If Google wants a quote from the person on the street, it would be this: "Is that one of them Apple Watches?" Yes, it's not even out and already Apple has cornered the public's awareness of smartwatches. The second quote would probably be "So what's it for then?", and this appears to be something even Apple hasn't nailed. What exactly is the point of a smartwatch? It's this that I struggled most with. I showed them the changing faces ("Ooh. It's not a real TAG though, is it?"). I showed them the replying to messages ("But can't you just answer it on the watch?" "No, there's no speaker" "Oh. The Apple one has a speaker though?"). I showed them the fitness, the navigation and more, all of which they raised eyebrows at until learning of the need for a phone for it to work in tandem with ("Surely it's just better to get your phone out, isn't it?").

It's safe to say two things. One: Google hasn't publicised Android Wear well enough for the man on the Clapham omnibus to be aware of it. And two: most of the public doesn't get smartwatches and, moreover, they don't care either.

## Day 7 - Time Runs Out

I went into this experiment with an open mind, willing to let the smartwatch impress me if it could, either with its

practicality or just with its futuristic allure. Certainly it's one of the most forward-looking devices I've had the experience in using for a while, a real look into the inevitable future. Part of me loved it, especially having what is essentially a very cool watch with practically any face you can dream of. This was helped by using the G Watch R and its superb round OLED screen, an experience that may be diminished on cheaper, squarer hardware. That other bugbear of the wearable brigade – battery life – didn't rear its ugly head for me, though I had accepted a nightly charge was needed and that I would therefore not be using it to wake me.

But it's there that the experience ran aground. Even with an update to Lollipop 5.0 on both the watch and Google's own flagship handset, I still had connection problems from the first hour until when I took the watch off for the last time. Even when it worked, I experienced annoyances like the one-line limit to replies, having to look like a bit of a fool talking to my watch, and trying (and often failing) to justify it to onlookers.

Many of these issues may well be fixed in the future, though, as the platform grows and the hardware becomes clearer focused. It's all a bit hit and miss now simply because all the manufacturers are breaking new ground with these products. The other thing here is, like watches and like phones, the experience is very individual. I found the watch didn't add to my lifestyle much, but for those more active or those who travel more, the watch may eventually prove indispensable for their everyday lives.

## Most apps on Wear at present are basic and reminded me very much of Java MIDP apps on phones of the early 2000s

There's a general view that smartwatches are a solution looking for a problem, and certainly for my week I found little to challenge this view. I enjoyed tinkering with the cutting edge of mobile technology but found nothing about it that I missed when it was over, beyond easy checking of notifications. It seemed odd for me to spend money on an expensive phone, only to then spend more on a device that allowed me to not look at that phone. This is the odd crux of Google and Apple's marketing too: "buy the watch so you don't have to look at the phone we also tell you is amazing to look at", and this is confusing the buying public no end.

In the film industry, there's a method of pitching a film known as the elevator pitch – summing up a film in the length it takes to ride a lift with a movie executive. If it can't be summed up succinctly in the 30 to 60 seconds, then it's unfocused, unclear and will fail the test. After my week with Android Wear, I still couldn't elevator pitch smartwatches to you, and I don't know if I'd want to either. Their purpose is unfocused, unclear and so far, they don't fail, but they don't quite succeed either. Maybe next year... mm



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## Apple's Force Touch And Taptic Engine

## **David Briddock** investigates the touchy-feely experience on Apple's latest MacBooks

n 9th March, at one of Apple's Special Events, CEO Tim Cook announced changes to its MacBook product line-up. Included in this was a brand-new, ultra-thin and light 12" MacBook plus an enhanced 13" MacBook Pro. Both models had Retina displays, a better keyboard, USB-C and other welcome updates.

Confusingly, the 12" MacBook is lighter than both the 11" and 13" MacBook Air products, which may well disappear altogether at some point.

However, what caught many people's attention was a completely re-engineered touchpad. It's a design that embodies both Force Touch, first mentioned for the Apple Watch, and the all new Taptic Engine technology.

## **Previously**

Before these models appeared, the state of play for trackpads on MacBooks (and any other ultra-format laptop for that matter) was a metal plate hinged at one end and usually balanced on springs.

Apple's design concept had two elements. Firstly, to remove any physical motion from the trackpad and replace it with a more subtle tactile feedback through the fingers. And secondly, to offer a range of pressure sensitive click events. This redesign would mean the trackpad becomes slimmer, lighter and more elegant – goals which always rank highly on Apple's product enhancement agenda.

As this new trackpad doesn't have any physical movement, click actions are triggered by finger pressure. Captured by four sensitive

pressure sensors, this push is translated into a click event, but the sensors can also determine the level of pressure exerted, so a 'deeper' kind of push can be translated into a Force Touch event.

## **Force Touch**

Internally, a Force Touch event is interpreted as something akin to a third mouse button press, a feature never before seen on any previous Mac mouse or trackpad, even though it's quite a familiar option to Windows and Linux users.

This new kind of event opens up many possibilities for an enhanced user experience and, importantly, this experience will vary between individual applications and even while performing different tasks in the same application.

An Apple support document (see Links boxout) provides examples of some of the shortcuts possible from a Force Touch event. These include:

- Safari and Mail links (web page preview).
- Finder file icons (document preview).
- Finder file name (edit file name).
- iMovie (timeline animation style options).

But what about providing some sort of click feedback? Because there are no moving parts, this was a key aspect of the design challenge.





It was achieved by employing some clever vibrational technology, which fools the brain into thinking the trackpad has actually moved during a click, so let's examine how it actually works.

## **Taptic Engine**

Many users will still expect some kind of feedback, as a substitute for the lack of physical movement. This is achieved through high-frequency vibrations and something Apple call the Taptic Engine.

At its heart the Taptic Engine hardware is pretty rudimentary. In essence, it's a series of electromagnets directly connected to a metal rail. Mounted underneath the trackpad's metal surface, this rail induces buzz-like vibrations every time a click event is detected. For a Force Click event, there's a second buzz.



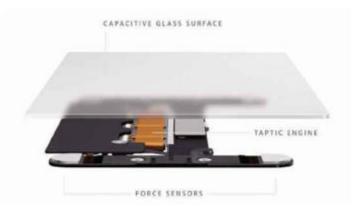
It might seem a little counterintuitive, but a precise horizontal jolt underneath a trackpad feels, to the finger tip, just like a downward click. In theory, the Taptic Engine could imitate a wealth of virtual feedback – for example, the edges of buttons and other user interface components, and even animated button movement.

## **High Quality**

There's nothing particularly revolutionary here. Similar feedback motors appear in game controllers and quite a few other devices. Yet, once again, it's all about Apple's quality of design, engineering and attention to detail.

The four pressure sensors are able to determine a wide range of pressure values, rather than just a click and force click. As they're located in the four corners of the trackpad, the software behind these sensors can determine the exact location of the finger (or stylus) applying the force.

Therefore, it's possible to capture both movement and pressure data at the same time, and this data opens up a multitude of smart interface opportunities, such as advanced signature



▲ Trackpad elements

verification, handwriting recognition and pressure sensitive drawing/painting tools.

Using the operating system 'Settings' app, virtual click pressure can be adjusted to become more or less clicky depending on your personal preference, and haptic feedback can be switched off completely if so desired, although many will consider this vibrational feedback an asset.

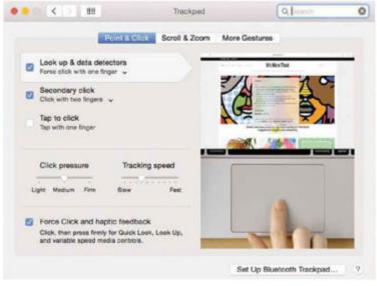
In addition, there's an audio feedback option, with three different settings. The lowest audio setting is most applicable for those who already prefer the 'tap-to-click' option, rather than a physical hinged press type of click.

## **Haptic History**

As always at an Apple event, the speakers like to present new features as something that could only have been envisioned inside its highly secretive labs. However, this isn't a new concept. In fact, haptic texture research can be traced back to work done by Margaret Minsky at the Massachusetts Institute of Technology (MIT) and Vincent Hayward at the McGill University over 20 years ago.

Completed in 1995, Minksy's doctoral thesis centred on applying a lateral force to simulate the feeling of texture. A custom software environment called Sandpaper subjected specific patterns of horizontal force to a joystick, which allowed users to 'feel' various textures.

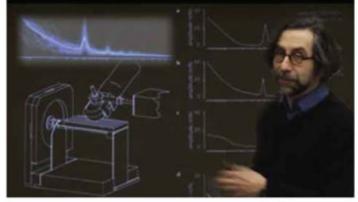
At around the same time, haptics pioneer Vincent Hayward, who has written dozens of papers on the topic, was producing phantom clicks with horizontal forces in his McGill University lab. Of course, 1990s technology was far less advanced than today, and Hayward's prototypes weighed as much as a modern MacBook. What Apple's



▲ Trackpad's Taptic Engine







▲ Vincent Hayward

lab team have done is to translate historical research into desirable technology for everyday computing products.

## **Electrovibration**

But some will argue that Apple's Taptic Engine technology shouldn't be seen as the latest and greatest take on haptic feedback. Other research groups are already starting to release details of their own intriguing tactile investigations.

One such group can be found inside Disney's Research labs in Pittsburgh. With help from colleagues at Carnegie Mellon University, this team is investigating a very different technique that dispenses with electromagnets altogether.

Named by Disney researchers as electrostatic vibration (and previously called TeslaTouch), it's based on a phenomenon known as electrovibration.

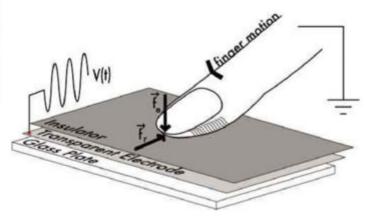
The idea to use electrovibration as feedback came from an accidental discovery by Edward Mallinckrodt in 1954. Dragging his finger over a conductive surface covered with a thin insulating layer and excited with a 110-volt signal, he felt a characteristic rubbery sensation.

What had happened is that an attractive capacitive force was generated between his finger and the metal surface. Although very weak, this force managed to simulate a rubbery surface touch sensation.

Varying the voltage, Mallinckrodt generated a range of tactile sensations that could simulate the act of touching other objects, such as glass, stone and types of textiles.

## **Electrovibration Benefits**

Since it doesn't need any motors or moving parts, the electrovibration surface can be any size or shape – as big as a room wall or curved like a car windscreen. And electrovibration is easily combined with other



▲ Disney Research Electrovibration

## Links

- Margaret Minsky's MIT project: goo.gl/7onF5X
- Taptic Engine teardown: goo.gl/smQhVz
- Force Click app support: goo.gl/obAEDg
- Disney Research: goo.gl/leUN5x
- Microsoft Research: research.microsoft.com
- **Senseg:** senseg.com
- iMovie 10.0.7: goo.gl/UPmhtA

tactile technologies, including capacitive and resistive touch screens. Most importantly, electrovibration feedback technology isn't exclusive to Disney. Companies like Senseg (**senseg.com**) also exploit this phenomenon and have demonstrated its distraction-free capabilities to automotive manufacturers.

And at least one Microsoft Research group also seems to be exploring electrovibration, so a future Microsoft Surface type cover may well offer a quite different kind of typing and trackpad experience.

## **App Updates**

Apple has already started to update a selection of OS X apps to cater for context-sensitive Force Touch events and Taptic Engine feedback.

So what sort of changes does this new trackpad usher in? Let's say you have a map on the screen. Using a Force Touch, you can zoom in and out multiple levels, without clicking the same button repeatedly, and you can drop a pin anywhere you'd like with a single Force Touch. It's fast and intuitive.

In iMovie, a Force Touch action allows you to quickly advance the timeline's frame rate. One single 'deep' press moves cycles through 2x, 4x, 8x and so on – much faster than clicking four times to raise the frame rate to 16 times normal speed.

As far as haptic feedback is concerned, an iMovie support document says that you'll feel a snapping sensation when you move movie clips around during editing. And you're also supposed to feel the beginning and end of each separate clip.

Many more apps already support a Force Click event, and the list (see Links boxout) keeps on growing.

To try it out for yourself, visit an Apple store or other Apple seller. After all, other manufacturers are bound to follow Apple's lead, which means your next laptop may well include similar technology.

## **More To Come**

As always, the Apple rumour mill suggests it has bigger plans for Taptic Engine technology.

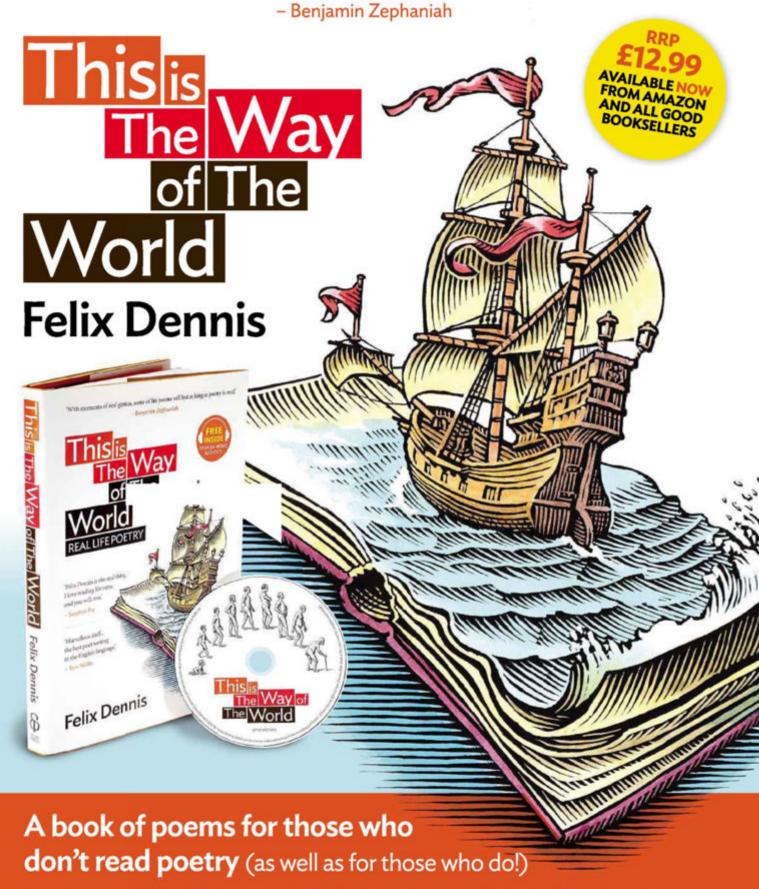
Apple could, for instance, allow users to feel the display interface under their fingertips by simulating smooth, bumpy or sticky sensations. In this way, text fields, buttons and scrolling lists could all feel very different to the touch.

This kind of feature would be extremely useful for tablets and smartphones, where certain tasks could be performed without having to look at the screen at all.

Take the virtual keyboard, for example. By running your fingers over it you'd be able to sense the different keys, giving a realistic touch typing experience.

Obviously, the Taptic Engine mechanism itself must be miniaturised for these kind of devicese, and this could be a problem. In reality, the electrovibration approach may be far more applicable for small-screen products, which means in future it may be Windows and Android handheld devices that offer the most flexible and cost-effective haptic feedback experience. mm

'With moments of real genius, some of his poems will last as long as poetry is read.'



A collection of 'real life' poems by Felix Dennis, one of Britain's best-loved poets, charting life's course from infant to endings with illustrations by Bill Sanderson.





## **Use For An Old Monitor**

As a recent convert to Micro Mart, I followed (well, I think I did) with interest the use for redundant monitors... Add a Freeview box etc. make a TV (page 34). Help! What am I missing? I added a SCART-to-VGA lead (eBay to the rescue), but no signal.... Yes, the TV aerial was connected, but no contact between Freeview box and monitor (complete with integrated speakers). Thought we'd got it made. Nooo. Two of us have tried this independently and the same results with two different monitors etc. Freeview boxes check out okay, as do monitors?

This was an interesting project that became short lived. Any help please, or was the author being hopeful?

Hugh Sheer

We think it might be the SCART-to-VGA lead that's causing the problem. If anyone else has any suggestions, please write to us and let us know.

## **Something For Nothing**

In response to Leigh Green (Movie Prices, Letters 1363), I'm afraid his conclusion isn't quite true. People really will pirate things just so they don't have to pay for them, no matter how little companies charge. If that wasn't true, then the Android operating system wouldn't be beset by piracy like it is. Apps only cost a couple of pounds usually, but that's enough for people to look for illegal downloads anyway.

The problem is everyone expects something for nothing. Raised on a diet of free websites and free music, they don't realise

the value of content. People's jobs rely on films, TV shows, books, magazines, newspapers and more being bought by other people. If no one pays for this content, the businesses go bust, people lose their jobs, and in the end the content itself suffers.

If you can't afford to buy a film, then you don't get to watch it. Simple. There's nothing that entitles you to have access to whatever content you want whenever you want it.

Steve Ripley

## **Gadget Gimmicks**

Isn't it funny how technology companies keep trying to convince us that we need this or that new thing and people just ignore them? Like video calling, for example. Yes, some people like to use webcams for social chat or for business, but they're in the minority. We've had the technology for landlines to have this kind of feature for a while now, but how many people do you know who actually own a video phone or who use their mobile phone regularly to do the same thing?

The fact is these great new features that we're supposed to get excited about actually make life more difficult or awkward.

Voice recognition is another one. Siri and its ilk are supposed to save us time and make us feel like we're living in the future, but their bad points outweigh the good a lot of the time. You can't use them in the quiet carriage of a train, for a start, and you don't always want people to know what you're searching for on your phone, even if it's something perfectly innocent.

The latest thing that they want us to buy into is curved screens on phones? Why? What on earth is the point? Give me a screen I can fold up to save space and I'm sold, but until we get to that point, I'm happy with what I've got.

Dan Taylor

## GET IN TOUCH..

## By email

letters@micromart.co.uk

## By post

Micro Mart 30 Cleveland Street London W1T 4JD

## **Online**

forum.micromart.co.uk



## **Component Watch**

## This week, we check out some variations on a particular graphical theme

he GeForce GTX 960 is Nvidia's latest mid-price card, and while it hasn't lived up to everybody's (quite high) expectations of it, few people would disagree that it makes a pretty decent graphics card to buy new if you can't afford the considerably more expensive GTX 970. To help make the purchase worth it, we've looked at a few GTX 960 models and found the best available price for each of them.

Deal 1: Zotac GTX 960 (2GB DDR5) RRP: £169.99 / Deal Price: £149.99

Zotac does the cheapest version of the GTX 960, giving you the lower price outright for the hardware. Specs-wise it's not much different from reference design, with three DisplayPort, one HDMI 2.0,



one DVI and a GPU clock of 1127MHz. It also has the standard 2GB of GDDR5 found in most low-end GTX 960s. It might not be the best version of the card in performance terms, but it's hard to argue with that price.

Where to get it: Box.co.uk - bit.ly/1FBR6QT

## Deal 2: Gigabyte GTX 960 (2GB DDR5) RRP: £180.78 / Deal Price: £149.99

Gigabyte's ITX-based GTX 960 is slightly superior, but then you do pay extra for it. As well as the standard set of reference features, Gigabyte's model has a slightly faster GPU clock: 1165MHz against the standard 1127MHz. It's not likely to create a massive difference, but Gigabyte's reputation is solid enough



that between it and the faster clock, if you can find it at the same price as Zotac's, there's no reason not to pick it.

Where to get it: Novatech - bit.ly/1Hv5WZN

## Deal 3: EVGA GTX 960 Superclocked Edition (2GB DDR5)

RRP: £172.16 / Deal Price: £161.72

EVGA's superclocked version of the GTX 960 has a GPU clocked at a faster-than-reference 1216MHz, but it's otherwise quite standard.

The price is a fairly big jump from cheaper versions, but the fact that the card is faster nicely mitigates this circumstance, even if there's nothing else interesting about the hardware. It's good, it's fast, and if it wasn't for the



last card on this list, we'd be telling you to go for it.

Where to get it: Ebuyer - bit.ly/1Hi4K6t

## Deal 4: Palit GTX 960 Jetstream (2GB DDR5) RRP: £179.16 / Deal Price: £163.15

Palit's GTX 960 Jetstream is the first version of the card to

feature a pair of fans cooling its factoryoverclocked GPU, but that excitement is partly undercut by the knowledge that its GPU is clocked at 1203MHz – slower than the previous, single-fan card. So either



the EVGA model doesn't have enough cooling or the Palit model has too much, and we think the latter is the more likely situation. But again, with such a small difference in price it's all largely rendered moot by the next card...

Where to get it: Scan - bit.ly/1KkGGq1

## Deal 5: MSI GTX 960 OC Edition (2GB DDR5) RRP: £179.99 / Deal Price: £163.49

This MSI GTX 960 basically shows the previous cards on this

page how it's done, with a factory-overclocked 1241MHz GPU clock (the fastest we've looked at) and a pair of non-reference Zero Frozr fans, which even stop spinning at low load to ensure a quieter card. For the sake of less than £15, it's hard not to recommend it. The perfect



balance of price and performance – as long as you can find it at a price this cheap. Luckily we've got you covered on that front.

Where to get it: Ebuyer – bit.ly/1dl7Wah



## New Bands From Beurer

Advanced sensors offer more data

# Windows: No Free Upgrade For Non-Genuine Users

## Microsoft pushes legit purchases

Microsoft executive has confirmed that non-genuine Windows users won't be eligible for a free upgrade to an above-board version of Windows 10.

Any non-genuine Windows users upgrading will be stamped with a "desktop watermark" notifying that the OS is non-genuine, according to Operating Systems bod Terry Myerson.

Mr Myerson also noted in a blog post on the issue

that "we are planning very attractive Windows 10 upgrade offers for their customers running one of their older devices in a Non-Genuine state."

In other Windows news, Candy Crush Saga will be preinstalled with the OS – with a blog post at Xbox Wire noting that the "added bonus" will be provided as standard for customers upgrading. Will this make users more likely to upgrade? Of course not.



# Fitness Tracker Faces Lawsuit

## **Sleep-tracking claims questioned**

lawsuit has reportedly been filed over in America claiming that Fitbit's suggestions that its fitness devices can accurately track sleep are not true. According to a couple of reports on the web, the California chap who has filed the lawsuit says that Fitbit's devices have been overestimating sleep compared with polysomnography (try saying that first thing in the morning), which is another means of tracking adopted by sleep scientists.

Referring to a 2012 study published in the Sleep Health journal, the lawsuit complains that Fitbit is misleading consumers as it is presenting its data on sleep as more accurate than it actually is.

The suit isn't the first class action Fitbit has been faced with in recent years as the popularity of its devices has grown, with a complaint over rashes caused by one of its products cropping up in the past. As for this current claim, the growing wearables industry will no doubt be keeping its collective eye on this one.

ealth and wellbeing brand Beurer has revealed its AS80 and AS80 C wristbands, complete with advanced sensors to provide more informative, interactive and detailed data on physical activity and sleep than ever before.

Designed for comfort and all-day wear, the AS80 is splashproof and its OLED X display shows a range of data at the touch of a button, providing users with set goals and targets. Data includes number of steps, distances, calorie consumption, activity duration and customisable

progress levels. As for the sleep tracker, that monitors sleep movements to look at rest type and quality, plus a wake-up alarm makes sure you get up without waking anyone else in the house.

Find out more at **www.beurer.com**.





# TNMOC Gallery Takes Flight

## **New exhibition showcases air traffic controller**

ore news from our friends at The National Museum of Computing, who would like you to know that it's just opened up a gallery dedicated to the past, present and future of air traffic control.

Now, you can satiate your inner pilot by checking out the exhibits, which include a high-fidelity Air Traffic Control Simulator, letting visitors either observe aircraft movements on a panoramic three-screen virtual airport or take up position for a hands-on controller experience.

Why is this happening at Bletchley? That's because the Park used to be home to the NATS engineering training college (NATS was once the National Air Traffic Services, but is now NATS Holdings a publicprivate partnership providing air traffic control services in the UK, and sponsorship for the gallery). With restored and working hardware plus radar recording systems and the rest, this sounds worthy of a visit for any flying – or just technology – fans among you. As always, the website for more details is (as always) www.tnmoc.org.



Following last week's panic over the strength (or lack thereof) of my various passwords, this week I've been thinking about the security of my wi-fi (thanks again, Mr Crookes).

Even though I seem to be the only person I know who has changed the default SSID of my wireless network and the default wireless key, I'm still aware that there are always going to be potential vulnerabilities.

It's a scary thought that someone could be connecting to your network and stealing your data, and it's just plain irritating if they're using your internet connection for free to download movies off the Pirate Bay or whatever.

As always, though, short of never using wireless, there's little you can do other than using best practice. That means changing those default settings and passwords, making it harder for hackers to gain access. There's still a chance it could happen, but why make it easy if you don't have to?

Anthony

**Editor** 

## Meanwhile... On The Internet...

he world of Information Security can be a murky on from time to time, and that fact has been exposed by the recent debate surrounding security researcher Chris Roberts' claims to have hacked the systems of Boeing and Airbus planes. In fact, it has recently emerged in FBI affidavits that Roberts' claims extend to him having taken control of engines and causing the plane to deviate from its course (tinyurl.com/Motl1364a).

Roberts was arrested earlier in the year, following a tweet claiming he had hacked a United Airlines 737/800 (tinyurl.com/Motl1364b) by compromising the in-flight entertainment systems, and it was during his questioning on that matter that his previous work came to light. Not that he's been shy about making claims over the years. Indeed, there's video dating back as far as 2012 where he talks about his success in hacking flight systems, and he even claims to have messed about with the International Space Station's climate controls (tinyurl.com/Motl1364c).

While not everyone believes that Chris Roberts has done what he claims to have done (and have gone to great lengths to explain why: tinyurl.com/Motl1364d), the idea is undoubtedly a frightening one that taps into a very modern paranoia. Either way, they're dangerous claims to be making – ruinous to a career if false, potentially ruinous to a career and your status as a free man if true (not to mention dangerous to the large of people you've put at risk), so one may wonder why you would make them unless you really saw the need. As nobody seems to be implying that Roberts meant any real harm with his actions, one can only assume that he really perceives this as necessary grandstanding.

In the Ourobous-like world of the internet, where everything is up for reappropriation, parody and outright theft, memes have become something akin to the common currency. Ideas, concepts or attitudes that are continually recycled to seemingly endless ends, pretty much everyone has used or come across one – whether or not they understand the anthropological background of the term, first coined by Richard Dawkins way back in the mid-70s (tinyurl.com/Motl1364g).

The shorthand nature of the internet meme – a simple image that instantly carries with it social and cultural baggage, is one the things that have made them so popular a target for advertisers in recent years, either in the form of attempts to create their own or the use of established memes in promotions. However, Delta Airlines has taken the appropriation of memes to a whole new level in a very unusual application: the creation of its latest safety video (tinyurl.com/Motl1364h). Described as the 'Internetest Safety Video On The Internet', it features multiple animals and people you'll recognise and even the terrifying dancing baby birthed by LucasArts, shared by email, taken mainstream by Ally McBeal and credited by many as the first internet phenomenon of this kind.

Frankly it's a work of gonzo genius that we can only applaud, though whether it will manage its obvious aim of getting audiences to put down their devices and pay attention remains to be seen. Perhaps that it comes close to trumping Air New Zealand's epic effort (tinyurl.com/Motl1364i) is praise enough.

## Aaaaaaaand Finally...

It's a geek's geek's geek's world these days, and there are few people who symbolise the rise of sci-fi culture in the way Simon Pegg does. As an actor, writer – and the man currently finishing off the script for the next *Star Trek* movie – it seemed strange that he would turn on the comic book movie in the way his interview with *Radio Times* seemed to imply (tinyurl.com/ Motl1364e). Indeed, he soon beat a hasty retreat via his blog (tinyurl.com/Motl1364f) claiming he was being "a bit trollish".



## AVWhy? Videos For Your Eyes... Not Necessarily For Your Brain

The technique of rotoscoping – where animators trace over a projected film image to either mimic the movement or add effects (www.tech-faq.com/rotoscoping.html) – is a well-used tool from the filmmaking kit bag. Perhaps the most famous application of the method pioneered by the legendary animator Max Fleischer in his *Out Of The Inkwell* series are the lightsabers in Star Wars (www.alienryderflex.com/rotoscope), but the technique has also been heavily used by animated films throughout the years – not least

those of Disney. Indeed, YouTube channel Movie Munchies has created two videos showing multiple occasions where Disney has used rotoscope techniques to repurpose old animations into new situations (youtu.be/pbjVjZrrE3w), saving the time and effort of the animation. Despite its age, it's a visual effect that still has the power to impress – to wit this remake of Taylor Swift's 'Shake It Off' video that's been Rotoscoped by animation students from the University of Newcastle, Australia (youtu.be/pbjVjZrrE3w). Most





reminiscent of the 'Lucy In The Sky With Diamonds' (tinyurl.com/mmdiamond2) section of the movie Yellow Submarine, it certainly adds a surreal twist to Swift's ditty and provides a wonderful showcase for the 49 students who animated the frames for the project.



## Caption Competition



When did you get your first mobile phone? We're guessing you were probably old than these two. Anyway, let's get on to those captions, shall we?

- Think Tank: "Snap chat buddies."
- JayCeeDee: "This is much more fun than those wooden blocks."
- JayCeeDee: "Oh no! Mum's putting more pictures of us on Facebook again. Can we un-friend her?"
- ...JB: "Technology, bro. Gran said we'd do much better than the tin cans she used."
- Thomas Turnbull: "This replicator app still has a few bugs."
- Stephen Cove: "I need a nappy, not an appy."
- Alex Moore: "First cut the umbilical cord, then get them attached to something else."
- Ian Davidson: "HTC happy tech children."
- Benji Archer: "I'm glad we're out of that womb. The signal was terrible!"
- Ed Winslet: "Looking Who's Talking 4G."
- Paul Neville: "These new phone are complicated, but baby steps..."
- Leigh Spriggs: "A Nokia? I'm a baby, not stupid!"
- Harriet Dane: "Why wait till you're a teenager to be antisocial?"

The winner this week 'Looking Who's Talking 4G", which was suggested by Ed Winslet. Well done!

To enter this week, head to the 'Other Stuff' section of our forum (forum.micromart.co.uk) and say something funny (but not too rude) about the picture below or email us via caption@micromart.co.uk.



## Price Cut For Raspberry Pi

## B+ slashed to just £16

o yourself a favour and get on this, if you haven't already invested some of your earnings in a teeny, tiny computer on a board.

Priced beforehand at \$35, the Raspberry B+ board is now going to cost you a mere \$25 (or £16 in UK money). The cost reduction is down to the fantastically vague "production optimisations" and the Raspberry Pi Foundation will be happy as this will surely mean yet more sales of a board that has already been selling well since it was released.

# Google Bubble Car Gets Go-Ahead

## **Public testing for prototype**

alifornia. Lands of forests, deserts, Disneyland and... self-driving cars.

Yes, Google's self-driving bubble car is now ready to burn some rubber on public roads. Before now, it's been a private affair only but if you happen to be driving on the roads of Mountain View over this summer – and if you are, lucky you – then you may chance upon one of a few prototype cars that will be in full glare of public scrutiny.

Speed will be capped to 25mph and they will always have a human being inside in case of any mishaps that have been part of the self-driving narrative in recent weeks. With a removable steering wheel, accelerator and brake pedals, full manual control is possible.

We'd love to see one of these cars for ourselves, but this summer we're more likely to be enjoying views of the back of a slow-moving lorry on the always busy M1. Such is life.

## Snippets!

## **Nintendo Brings Back World Championships**

Nintendo has decided to resurrect its World Championships event for the first time in quarter of a century. With qualifying events in Best Buy locations around the States planned beforehand, tournament finals are due for the 14th June, just before this year's E3 event starts in earnest. The first, and indeed last, World Championships took place back in 1990 when Nintendo toured US cities testing gamers on Super Mario Bros. and Tetris.

Further details are minimal but suffice to say that we're a smidgeon jealous of our American friends.

## **Doom Goes Boom!**

Oh this is fantastic. Creators of Doom, Bethesda Software, have let loose a teaser of its reboot of the classic shooter with a full unveiling of the title due at this year's E3 show in LA. As short as the teaser is – and, boy, is it short (just a few seconds) – it has an undoubted nostalgia quality about it. Bluntly, it got us all excited inside. Track it down online and feel the same way, why don't you.

## **President Tweets.** #IsThisSuchABigDeal?

President Obama has joined Twitter. You will find him at **@POTUS** if you're into that kind of thing and you'll be in good company – he had 1.68m followers the last time we checked, and had apparently broken the record for the fastest time to one million. As for the President's first tweet? It wasn't a bad effort:

"Hello, Twitter! It's Barack. Really! Six years in, they're finally giving me my own account."

Ho, and indeed, ho. That post attracted well over 230,000 retweets at the last glance. We're not jealous, oh no no no.

## EE Bags 10m 4G Users Most 4G users in Europe

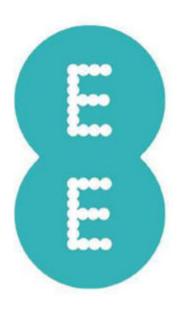
f further proof was needed that everything Kevin Bacon touches turns to gold, EE's powerful marketing message surrounding its 4G network has paid off.

The operator now has over 10 million customers signed up to its 4G network, becoming the first European operator to reach that figure. EE says that if the current pace of growth continues, it will support an Exabyte of data per year by 2018, triple the amount of data the network supports currently. The network also revealed that it's running more

traffic over 4G than 3G for the first time.

While this is all great news for the network, its popularity is leading to more complaints, as Ofcom has said that EE has received the most moans of any mobile service iduring Aprilto-December last year, with its broadband service also 'topping' the charts, There's work to be done, then, but perhaps this is in part down to the growth in the numbers now on board.

Meanwhile. BT is keen for its takeover deal of EE to go through claiming that it's not going to affect the market in any negative way.



## Oculus Rift Will **Be Windows Only**

## No Mac or Linux support on the horizon

he tech specs of the Oculus Rift VR headset are out there and it appears that Linux and Mac users are going to have to wait a little while until they can join in the fun.

A blog post on the specs from a chief architect at the company confirmed that "development for OS X and Linux has been paused in order to focus on delivering a high quality consumer-level VR experience at launch across hardware, software, and content on Windows." The post also stated that while Oculus hoped to resume development for OS X and Linux, it doesn't "have a timeline."

Boo, hiss and all that jazz, which will also be the case if you're a confirmed laptop user, as we were also informed that such hardware simply won't be able to handle the required frame rates and that anyone wanting to get on board with the project would need a dedicated, high-end graphics card and processor setup: Windows 7 SP1 or later, Intel i5-4590 processor, Nvidia GTX 970/AMD 290 or better graphics card and 8GB RAM, to be specific.

The power is needed to render 400 million shaded pixels per second for a smooth experience, so this is going to be a case of high-end early adopters enjoying the Oculus vision of the future.



# HyperX Invites You To 'Meet The Pros'

#### Pop-up event in London this weekend

f you happen to be around London's Soho area from 27-31 May you may like to hang around at HyperX's Pop-Up Shop at Peter Street.

The Kingston memory division has joined up with Intel and Overclockers UK to create a "fully immersive gaming experience" for gaming enthusiasts to go head-tohead with professional players. Competing on recently released driving title *Project Cars*, players grabbing the fastest lap times will bag daily prizes including peripherals and accessories, plus a grand prize of a custom gaming rig could be won in the final day of competition.

Naturally, you'll also be able to buy all manner of HyperX products too and it sounds like this could be worth a look if you're in the area.

# 4K Vision From ViewSonic

#### **Ultra HD monitor from screen specialists**

ward-winning monitor pro ViewSonic has cooked up its latest 4K monitor in the shape of the VG2860MHL-4K. Aimed more at business professionals, the price of £369 certainly means that anyone wanting an ultra-HD experience in their home setup won't be completely priced out of this one. The 28" screen has a 3840 x 2160 at 60Hz native resolution, displaying four times more images with twice the detail of a full HD monitor.

Ten-bit colour processing delivers 1.07bn colours for smooth greyscale and lifelike imagery, while features on the monitor include picture-inpicture, picture-by-picture and equally-split horizontal and vertical images.

Connectivity is catered for with DisplayPort 1.2 and Mini DisplayPort 1.2 both supporting 4K resolution at 60Hz, plus HDMI and four USB ports are available for mobile devices, Blu-ray etc. A 2ms response time, built-in dual speakers and a Blue Light Filter for a more comfortable viewing experience complete the important stuff and you should head over to www.viewsoniceurope.com/uk



for more details.

## SoftMaker Office 2016 Lands

#### Optimised to be faster and more responsive

he latest iteration of the SoftMaker Office suite is here, but with a 2016 tag, and it promises a faster, more responsive experience with interoperability with all major Office file formats.

Utilising more CPU cores to get your tasks done without lag, the suite opens and saves in newer and older XML-based and binary formats without losing any formatting and boasts over 400 improvements over the current suite. These include support for 4K

monitors, zooming and scrolling on Windows 8 touch-screen devices and support for photo frames on each of its word processor, spreadsheet and presentation tools.

Included, Thunderbird and Lightning handle e-mail and scheduling and the suite comes with a license for up to three PCs. You can test it for free for 30 days by downloading the evaluation version from **www.softmaker.com** and then decide whether it's worth the £72.40 for the Professional version.



▲ Office screenshots are pretty dull, so here's a big picture of a strawberry instead

# REVIEWS

## **Pioneer FREEme**

#### Michael checks out a portable Bluetooth speaker

# DETAILS • Price: £129.00 • Manufacturer: Pioneer • Website: www.pioneer.eu/uk • Required spec: n/a

ith the tagline of

'Listen in Style', Pioneer has released its FREEme Bluetooth speaker product, which delivers audio output from two 40mm fullrange speakers backed up by a passive radiator. This portable device has dimensions of 151 x 45.5 x 8.2mm and weighs 361g, so it can easily be transported in a pocket or bag. Two versions of the product are available. The IF1 model comes in a choice of black, white or aqua rubber covering, while the more expensive IF3 version has a choice of black or brown leather livery. My review unit was the black IF1 FREEme.

In common with numerous other devices performing a similar task, the FREEme is powered by a lithium-ion battery pack that is rated at around seven hours of power. However, unlike these other devices, the FREEme comes with instructions on how to replace the battery. While I haven't tested this replacement feature, I have managed to squeeze over ten hours of playing time from a single battery charge.

With the body of this Bluetooth speaker encased within a perforated metallic grill, the unit's various controls are concealed on the rear of the device rather than the more convenient top of





the unit. Running from left to right, these controls are made up of a micro-USB port for charging the battery, aux input, a pinhole reset option, phone call button, volume level adjustment, Bluetooth pairing and power on/off. With power turned on, a white light will appear on the front of the speaker.

There's one other control, which involves the unit's NFC (near field communication) support. This can be activated by holding your smartphone or tablet close to the top of the FREEme. The power light will flicker while the connection is established before reverting to a steady glow.

Standard Bluetooth pairing is generally quick and straightforward as you hold down the pairing button for a second. If necessary, the standard 'OOOO' password can be used to complete the connection. The FREEme can hold details of up to eight separate Bluetooth connections, although only one can be active.

When the FREEme is linked to a smartphone, then it can act as a speakerphone for receiving and making calls. Incoming calls are announced with a ringtone as the music is put on temporary hold. Depending on a short or long press of the FREEme phone button, a call can be accepted or rejected. In the case of the latter, or when a conversation is ended, the music output will be restored.

As mentioned earlier, there's an aux connection for use by

devices that do not support Bluetooth. When a device is connected via the aux option, it will take preference over any Bluetooth output. It does not stop the Bluetooth output, which continues merrily on its way, but you just do not hear it.

Audio quality was reasonable for a device of this size, and you can download the free Pioneer Wireless Streaming app in order to make certain adjustments to the FREEme audio output to help justify the price of the product. Pioneer has included two- and three-pin plugs with an AC adapter, non-slip sheet and a drawstring carry pouch. mm Michael Fereday

## Reasonable output but a little pricey for its functionality





# **Quiet PC UltraNUC Pro**

#### Just when you think a performance PC couldn't get any smaller...



e've had our share of ultra-compact PCs through our door of late, and most have left us with a very positive impression. However, there is one tiny PC that has so far eluded our test bench: the Intel NUC - until now, of course

The Intel NUC (Next Unit of Computing) barebones platform has quite a following these days, thanks to the amount of computing performance that can be shoehorned into such a diminutive case.

Ouiet PC's take on the Intel NUC, the UltraNUC Pro offers an extensive range of configurations through the custom build area on its site. The model we have on test here has an Intel fifthgen NUC Core i3 5010U at 2.1GHz, 4GB of 1600MHz RAM and a 128GB Samsung SM951 M.2 SSD, on which there's a copy of Windows 8.1.

Despite the minute proportions of the chassis, the UltraNUC manages to pack in a surprising amount of connectivity. The front of the case houses a pair of USB 3.0 ports, with one having super speed charging, along with a 3.5mm headphone/speaker out audio port. At the rear of the case, you'll find another two USB 3.0 ports, gigabit Ethernet, mini-HDMI and mini-



▲ The Ouiet PC UltraNUC Pro is an extraordinarily small PC



A But one that packs a lot into its micro frame

DisplayPort, as well as the power port. All this on and in a case that measures just 115 x 111 x 32.7mm, and which weighs around 400g.

The UltraNUC is extraordinarily well put together, a neat little package that works extremely well under normal computing duties. It's ideal as media centre or a unit to fit behind a monitor, which is helped by the inclusion of a VESA mount in the package. The colour scheme reminds us of the older Revo R3610, with the white/gunmetal grey on black shiny plastic. Obviously the design is significantly different in this case, and in many ways

it's a more convenient shape and weight compared to other mini PCs we've tested in the past.

Windows 8.1 worked extremely well on the UltraNUC; there weren't any problems with loading the OS or navigating around it. Likewise, office duties were a breeze, and our collection of older games ran without any difficulty.

Speaking of which, the HD5500 GPU on the UltraNUC isn't the most powerful builtin graphics engine, but it did manage to handle the likes of Assassin's Creed 4 and Left 4 Dead 2 reasonably well, so there are some gaming

qualities hidden within this tiny PC. Media and HD content played flawlessly; we even had our test 4K video play without the system struggling.

Cooling doesn't seem to be an issue here, thankfully. The UltraNUC is deathly silent, and at times you'll actually need to check the power LED to make sure it's on. Also, thanks to the abundance of vents along the sides and back of the case, there's enough airflow to keep it cool. Even with the tests we conducted, including the media tests for a couple of hours, the top of the UltraNUC was only slightly warm to the touch.

We really enjoyed our time with the Quiet PC UltraNUC Pro. It's an extremely capable mini PC with ample connectivity, which can be configured to become more of a gaming powerhouse if you want. There's only one negative we can think of and that's the use of mini-HDMI instead of a full-sized port. mm David Hayward

#### An excellent mini-PC with plenty of performance and potential



# ViewSonic VP2780-4k

#### ViewSonic tries to muscle into the professional market with a new 4K screen

#### DETAILS

- Price: £699 inc. VAT
- Manufacturer:
- ViewSonic
- Website:
   viewsoniceurone
- viewsoniceurope. com/uk
- Required spec: DisplayPort or HDMI output

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ot long ago, I covered ViewSonic's VX2880ml, a 28" 4K screen for less than £500. The problem with that display was that it only supported 30Hz in 4K resolution, making it less than optimal for gamers.

Learning from those lessons clearly, the VP2780-4K is a marginally smaller 27" panel that can deliver 60Hz operations at full resolution, even if it's really built for CAD engineers and photographers.

Monitors that start with VP from ViewSonic are part of its professional range, and for that sector the price of less than £700 is something of a tease, to people used to paying double that.

And unpacking this for the first time, the design certainly looks the part. It comes pre-attached to a chunky support arm that offers plenty of vertical travel, enough to spin the screen into portrait mode when required. As it's built on IPS technology it features 178° viewing angles in both horizontal



and vertical, making it ideal for rotating.

To retain stability while the screen moves, the front feet of the support are widely placed, but without this design choice it would be generally unstable when at maximum vertical positioning.

Specifications

- 27" 4K UHD IPS monitor with 100% sRGB and 99% EBU for CAD/CAM, video editing, photography
- Natural resolution of 3840 x 2160
- 1.07 billion colours with Delta E<2 for accurate colour performance
- HDMI 2.0, dual DisplayPort, MHL 2.0, 4 x USB3.0 ports
- Multipicture support for viewing up to 4 video sources
- Fully ergonomic stand with pivot, height adjustment, swivel and tilt

The support stand provides a strong and stable base, and the input port options are equally impressive. You get two DisplayPort inputs, one each of full size and another mini-DP option, and no less than three HDMI ports. One of these HDMI ports is the new 2.0 spec with 10-bit colour support, and the other two are the lesser MHL 2.0 standard.

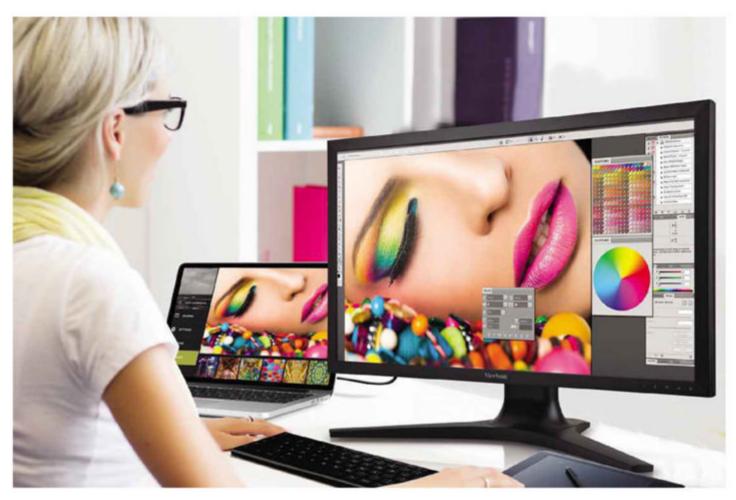
My first reaction was to wonder in what situation you might need five potential inputs. However, it transpired that ViewSonic's picture-in-picture (PIP) technology actually allows you to use the 4K resolution to display four 1080p sources at any one time. And for good

measure, it also has a four-port USB 3.0 hub built in.

But the real party trick of this design is its colour presentation, because according to ViewSonic, the panel in the VP2780-4k can deliver 100% sRGB, and 80% of Adobe RGB definition with a colour variance (Delta-E) of less than 2.

While to most people the colours just 'look good', these are the sorts of specifications that make those working with colour professionally swoon. As a reviewer, my problem is that my colour calibration hardware just isn't up to the job of demonstrating this level of quality, and the human eye can only detect a Delta-E of





1.0. Across the majority of the ViewSonic VP2780-4k's colour range, pixel colour variation is more subtle than that margin and therefore beyond a human's ability to appreciate.

There is only one slight fly in this multi-spectral ointment, and that's a slightly inconsistent backlight. It's definitely brighter at top centre than the corners, but only by a degree that would be noticed by professional designers. That's a minor shame, because in almost every other respect the VP2780-4k is a very classy act indeed.

It needs to be stated that colour accuracy is often held hostage to fortune by the actual environmental lighting that designers work in, and unless it's tightly controlled, any discrepancy exhibited by this screen will be a significant factor.

For those who aren't diagnosed as pantone positive, this display delivers a very rich gamut that brings photographs, videos and 3D games alive. There isn't much movie or TV content available at this resolution, but what I could find looked stunning and oddly 3D, in a way that stereo separated imagery fails noticeably to successfully convey.

The question that needs to be asked is whether you could use this at home. If you have the cash, then I don't see why not, unless you're a frame-rate obsessive wanting the almost lag-free refresh that only TN displays can deliver. But as IPS and 4K screens go, there's surprisingly little input lag or lack of response at 60Hz, amazingly.

These idiosyncrasies aside, this is a remarkably high-quality screen that ViewSonic currently offers with a zero dead-pixel warranty. And at this quality level, the price is a snip even if it might seem excessive for most consumers.

There are still ongoing issues using a 4K screen for the Windows desktop and in games I've noticed, but these are likely to be addressed as products like this one become more commonplace.

In the meantime, if you'd like decent 4K panel but refuse to pay silly money, then the ViewSonic VP2780-4k is a very plausible option.

mm Mark Pickavance

### A 4K display that play and work equally well



# Ashampoo Music Studio 6

#### Ashampoo presents an upgrade to its Music Studio suite



his is an update to the
Ashampoo's Music Studio
program that I reviewed
last year. For those that
are not familiar with the product,
it's essentially a collection of
associated utilities collated into a
main menu. They cover all the
essentials from extracting or
recording your audio files,
through modifying and
organising them, to finally
burning the results to CD or hard
drive. It also includes a basic
method of labelling them as well.

With this release it's increased the main menu from eight to ten options, adding a playlist generator and an audio splitter. The playlist generator is quite a useful utility that's more comprehensive than the one built into Windows Media Player. It has a simple point-and-click interface





▲ The program will lift artist and track data from your CDs

that makes it easy to pick tracks from different folders. It will also collate the chosen tracks, picking up the artist and song titles from the source files (of course, assuming this data was saved in the first place). Alternatively, it will search the Free-DB database online, to see if a match can be found. Once the list is complete. you can save it in a range of different formats, which are generally compatible with most of the popular audio players. This version also supports the Apple formats AAC and m4a. So you can burn your music to disc or convert iTunes songs into MP3 and WMA format, to listen on your home stereo or other devices without iTunes.

I wasn't really convinced that the audio splitter was a particularly useful feature, but of course if you have a live concert recording, it would allow you to split away individual tracks or perhaps remove some of those you're not particularly keen on. It could also be used to create ringtones from any of your MP3 recordings, which for some phones have to be kept under a certain length. Another

useful feature of the splitter is removing those annoying twosecond gaps you sometimes get in live recording.

Obviously one of the main features of the Music Studio is audio ripping, where it can extract the audio tracks from CDs, video files, audio tapes and vinyl discs, automatically creating playlists in the process. This it does very well. You can chose from a number of output formats, setting the sample and bit rate and whether you want a mono or stereo recording.

After ripping, Music Studio offers a number of more advanced editing options, where you can globally change the volume levels to maintain a constant or normalised level. This is particularly useful if you're compiling a selection of tracks for an event, which could potentially have different volume settings. You can also optimise the ripping to accommodate audio tapes and vinyl discs (what we in the UK refer to as records).

Other advanced features include multi-track overlay and editing, which includes the facility to record a microphone input

over your music. You can also edit the raw data as a waveform, changing the volume, or fade the start and end. There's also a graphic equaliser where you can completely change the tonal value of individual tracks.

I mentioned in my last review that the editor for creating and printing your CD covers and labels was somewhat lacking in features. Well, there's been some improvement, because it now lists many more compatible printers, my own Canon MG5450 being one of them. Quite an important point really, because my printer will print directly onto CD or DVDs. Sadly it doesn't retain the printer information, so you have to select it every time. Also, the editing functions are still somewhat primitive compared to similar products. While you can import your own background graphics, there's no facility to search for online graphic content, but at least this version will now import artist and track data from the CD itself.

If Ashampoo can fix these problems, then it's surely on to a winner here.

mm Joe Lavery

## Remains good value, but with a little work could be even better





# BenQ GW2765HT

#### Looking for an IPS, WQHD monitor for under £300? Then read on...



espite advances in monitor technology, trying to find a good IPS display that can hit WQHD resolutions for under £300 is still something of a gamble. There are a number of them available, but finding the right one, with decent connectivity and from a company you can trust can be fairly difficult.

BenQ, though, may have the answer in the form of the GW2765HT. This is a 27" IPS monitor with a resolution of 2560 x 1440, and using the Flicker-Free BenQ Eye-Care technology to deliver a stunning image that's easy on the eyes.

Other features include a dynamic contrast ratio of 20,000,000:1, 350cd/m2 brightness, and a response time of 4ms. Connectivity is good too, with HDMI, DVI, DisplayPort and VGA; there's even a pair of 2W speakers built into the frame.

It's surprisingly ergonomic as well, with height adjustment, swivel and tilt built into the monitor arm, which requires screwing into the rear of the monitor with the VESA mounts. It's a little ungainly to fit, and once everything is screwed into place, the movement is a tad stiff, especially for the tilt. But the design is secure enough, and there's no sign of wobble or a lack of build quality.

The aesthetics of the GW2765HT aren't the best we've ever seen, admittedly. The piano-



↑ The BenQ GW2765HT is a good IPS monitor



▲ There's more connectivity than usual, and good ergonomics as well

black, glossy bezel is something of a fingerprint and dust magnet, and there's some reflection off it if the monitor is angled toward a light source.

However, where the GW2765HT may lack in its design it certainly makes up for in the image that's displayed on the screen. We found it to be one of the best we've seen from a 27" panel. The colours are crisp, and the brightness level is fantastic. There's also a reduction in eye strain, and you can tell the Flicker-Free technology makes a difference to how the image is presented and viewed. Viewing angles are good at 178° on the horizontal and vertical; there's just a slight drop in the colour tone when looking at the screen from the extremes of the viewing angles.

The preset Game, Photo and Movie modes are a little dark for our tastes. Thankfully, you can adjust nearly every aspect of the image through the OSD, which can be accessed through a set of six buttons around the back of the right-hand edge of the panel. The eye-care modes – Office, Reading, Multimedia and Surfing - are designed to lower the brightness and blue light levels and reduce the strain on your eyes. While they do indeed work, again we much preferred the levels we could customise over anything that was preset.

The BenQ GW2765HT is a good, high-resolution monitor. It's great for everyday tasks, as well is gaming and viewing HD content. We liked the ergonomics and the quality of the screen, as well as the connectivity on offer, and the price isn't too bad either. It would be better of course if there was a USB hub built into the monitor, and we'd prefer to see a matt-black finish throughout, but on the whole we're impressed.

A good monitor, with excellent ergonomics and less eye strain



# ThumbsUp Neoglow Earphones

#### We look at some 'flashy' budget earphones

# • Price: £19.95 • Manufacturer: ThumbsUp • Website: tinyurl.com/prxtvhd • Required spec: Any audio device with 3.5mm output

ost technology products, like USB hubs and wireless keyboards, are created to solve a problem or make life easier. Nevertheless. there has always been and always will be plenty of room for more frivolous items too. From telephones shaped like hamburgers to pen drives that resemble cartoon characters, these features add nothing other than a kitsch appeal and a sense of fun. Quite often the actual functionality of these products is bog standard at best. Is that the case with the Neoglow earphones, though?

Their key selling point is the fact that the main cable contains an "electroluminescent wire" and "sound reactive technology", which basically means it lights up (in blue) and flashes in time to your music, so slow music should mean slow flashing, while more upbeat tunes should see you illuminated like a oneman disco. This function can be turned on and off using the silver button on the builtin control module, which is recharged via a micro-USB port on the side. (This button can also be used to answer phone calls on a smartphone.)

But ThumbsUp also promises a "Comfortable fit with high quality sound" – a potentially more difficult target to meet,





considering their relatively low price. Sadly, they only succeed in one of these aims. The rubber earbuds fit snugly into your ears and provide a decent amount of noise isolation, so you shouldn't find your favourite Gene Pitney album being spoiled by the sound of your colleagues, friends or family trying to engage you in conversation. The problem is, if anything is going to ruin your enjoyment of 'Twenty-Four Hours from Tulsa', it's the Neoglow earphones themselves.

Although not terrible, the sound from these earphones is distinctly muffled, like listening to a radio with a quilt over your head. On the plus side, we didn't hear any distortion at high volume, and the bass

response wasn't the worst we've ever heard from budget earphones. But even taking that into account, the fact remains that the audio quality is just not good enough, even at £20, because you get the feeling that if they didn't flash, the Neoglow earphones would probably retail at closer to £10 (maybe £15 on the high street).

Unfortunately, this isn't the only problem with these earphones. In spite of the chunky module on the cable, which also houses a microphone, there are no volume controls. Why such a basic feature was omitted is a mystery, because it would have made these earphone far more appealing.



Ultimately, the Neoglow earphones are a novelty product, but their price doesn't quite reflect that. In their favour, though, the flashing effect is a lot of fun, and if you want to get noticed and to turn heads, they're sure to do that. It's a shame there isn't a choice of colours, but that's perhaps something that ThumbsUp will introduce further down the line. Regardless of the colour, though, whether you should buy these depends on how important looks are to you over sound quality. If you accept that your music isn't going to sound its best, then they're an interesting, if slightly overpriced, prospect.

mm Anthony Enticknap

### Sadly, they don't sound as good as they look





# **Roccat Kave XTD 5.1 Analog**

#### Become completely surround in sound

# DETAILS • Price: ~£79.50 • Manufacturer: Roccat • Website: goo.gl/UDds8B • Required spec: Soundcard with centre, rear, sub and mic jacks, spare USB port to power headset LEDs

occat has had a good run of decent gaming peripherals of late. The Tyon mice range and Ryos keyboards have all scored highly in both the eyes of reviewers and gamers alike.

The same can be said for the headsets on offer, in particular the Kave range. We've reviewed a Kave headset from Roccat in the past and found it to be a great addition to the gamer's arsenal. Now, though, we've managed to get our hands on the higher end of the Kave scale, the Kave XTD 5.1 Analog.

The Kave XTD offers a 'real' 5.1 surround sound setup thanks to three main drivers in each ear cup. There's a pair of 40mm drivers covering the centre, front and rear, with a third 30mm vibration driver that gives quite an explosive level of bass.

The left ear cup houses a detachable, omni-directional microphone with excellent noise cancelling technology – complete with a mute LED quick recognition notification on the mic's tip. It's a small enhancement, but one a lot of avid headset-wearing gamers are keen on having.

There's a long, three-metre, tangle-free cable with a dual-mode remote located roughly halfway along. The remote is a pretty solid affair and features



↑ The Roccat Kave XTD 5.1 Analog headset is singularly impressive



▲ The remote is simple but effective

66 Gaming sounds superb, but also films and music

have extra depth 🦠

a number of controls that are easy to reach without fumbling around. From it you can alter the volume levels of each driver (front, centre, rear and sub) and switch between movie and game preset modes, as well as turning the mic on or off. You can either clip the remote to your shirt, or you can clip it in a Desktop Mode to an included

bridge that will sit near your keyboard or mouse.

The cable terminates with a USB connection and four 3.5mm audio jacks. Naturally, you'll need a soundcard setup that can accommodate the four audio jacks. If you do, then you're in for a real treat, as the sound quality from the Kave XTD 5.1 is absolutely superb.

Every detail of each audio range is picked up with near perfect clarity. Gaming sounds superb, but also films and music have extra depth and come alive once you put the headset on.

In terms of comfort, the ear cups and headband are extremely well padded and can be worn for a length of time without any signs of discomfort. There's also a higher than normal amount of noise cancellation thanks in part to the cushioning and padding on the ear cups, but also due to a Zero Noise Interference Isolator Roccat has installed in the headset. This innovative piece of technology apparently cuts out any electromagnetic interference from other components. As to how much it actually does cut out we're not sure, but suffice to say we were cocooned in a shell of near silence when we wore the Kave XTD.

The Roccat Kave XTD 5.1 Analog headset is an excellent buy for the avid gamer and audiophile, but at £79.50 or thereabouts, it's quite pricey. But you get what you pay for, and in this case it's an extremely good headset with superb 5.1, hardware-driven surround sound.

mm David Hayward

Excellent quality headset, although a little expensive



It's been a while since a server was a towering monolith that gently hummed in the centre of the server room, while IT staff rushed around and fed its every whim. Now, there are plenty of mid-tower server units available and at a reasonable cost too. David Hayward takes six to his underground, air-conditioned bunker and tests them out to see which of them are worth considering

#### **Tower Servers**

### **Lenovo ThinkServer TS140**

- Price: £390
- Manufacturer:
- Website:
- goo.gl/Z0J4VI
- Required spec: Server software, **Linux or Windows** (licence needed)

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rom a business perspective, Lenovo has its eye on the ball. The company has its hands in virtually every conceivable industrial and commercial pie there is, from engineering through to science, government, education and health. Suffice to say, it knows a thing or two about producing a cost effective tower server.

The Lenovo ThinkServer TS140 is one of the newer chassis designs within the ThinkServer range. It's not quite as domainlevel orientated as the TD350 range, but then nor is it as lightweight as the TS130. This puts in a unique position that combines functionality and cost effectiveness, both keywords executives like to bandy around a boardroom.

The TS140 is a 4U tower form factor measuring 174 x 425 x 430mm and weighing in the region of 11kg. Our model came fitted with a Lenovo C226-C2 motherboard on to which there

was an Intel Xeon E3-1226, quadcore 3.3GHz processor, 4GB of 1600MHz ECC UDIMM memory and a single 1TB hard drive installed. OS not included, then.

The motherboard offers good connectivity in the form of four USB 3.0 ports, a pair of USB 2.0 ports, VGA, two DisplayPorts and a single gigabit Ethernet port. On-board there are four memory slots with support for a maximum of 32GB, five SATA ports with RAID levels 0, 1, 5 and 10, two x16 PCle slots, a single x1 PCle slot and a single PCI slot.

The TS140 can happily house four 3.5" SATA 7.2K 6GB Enterprise Drives, to a maximum of 16TB total storage, and through the Intel Advanced Management Technology built into the motherboard you'll be able to configure the setup to your individual needs. Optional extras come in the form of remote management, up to eight gigabit Ethernet ports, rack mounting kits and various KVM options. However, while the amount of you can pack in to the chassis of the TS140 is impressive, equally of note is the lack of noise once it's powered up.

We only has a single hard drive fitted in the case of this test and were running a copy of Ubuntu Server 14.04.2 LTS, but the TS140 was remarkably quiet considering its business-like heritage, where silence isn't so much of a driving force compared to a home PC.



▲ The Lenovo ThinkServer TS140 is one of the quietest servers we've ever used

Anybody who's spent any time in a packed server room will no doubt tell you that the possibility of a conversation that doesn't require you to shout an inch from the other person's ear is a glorious thing indeed. The TS140 may not eliminate all noise, but it's far quieter than most tower servers we've worked with in the past.

The Lenovo ThinkServer TS140 therefore may not be the most powerful server, but it's certainly more than capable as a solid workgroup resource. It can be upgraded relatively cheaply, it's energy efficient and you can grab the base model, such as the one we tested, for as little as £390. This makes it far from a bad choice for smaller server room deployments or individual and workgroup solutions.



▲ There's ample room inside for potential upgrades





### **Fujitsu Primergy TX1310 M1**

- Price: £430
- Manufacturer: Fujitsu
- goo.gl/RfAPdv
- Required spec: Server software, **Linux or Windows** (licence needed)

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ujitsu may not have the server room presence that the likes of Dell, HP or Lenovo enjoy, but the company's server product range is a lot stronger than most people expect. The Primergy TX series, for example, offers everything form the entry-level TX1310, which we're reviewing here, up to the immensely powerful TX300, with its support for multiple 12-core Xeon processors. In short, there's something for every server-based situation with in the product range.

The Primergy TX1310 may well be the baby of the group, but that doesn't mean it's without its fair share of computing power. The D-3219 motherboard is fitted with the same Xeon E3-1226 V3 3.3GHz



▲ The Fujitsu Primergy TX1310 M1 is a fairly standard machine



▲ It's reasonably quiet and does a decent enough job

quad-core processor we saw previously in the TS140, but this time we have a total of 8GB DDR3 memory and a pair of 500GB hard drives, on to which we had a copy of Ubuntu Server 14.04.2 LTS installed.

Rear IO connectivity is good, offering four USB 2.0 ports, two USB 3.0 ports, VGA, serial and a pair of gigabit Ethernet ports. We even had a further dual Intel gigabit Ethernet card pre-fitted. On the motherboard itself, you'll find four DDR3 memory slots supporting a total of 32GB, two PCIe x16 slots, a single PCIe x1 slot and a single standard PCI slot; there's a total of six SATA connections supporting RAID levels 0, 1 and 10. Interestingly, you'll find a USB 3.0 port located on the board, so you can fit an internal backup solution.

The server chassis measures 175 x 419 x 395mm and weighs around 14kg. It's a fairly standard

design, as far as server towers go, but there's plenty of ventilation and cooling thanks to the large mesh area at the front of the case. We did like the screwless chassis and the fact that the drives can be mounted on rails for easy fitting.

The server was reasonably quiet, although not as quiet as the previously reviewed TS140. There's little chance you'd hear it over the continual drone of the air conditioning in a server room, though, which is a bonus.

The Fujitsu Primergy TX1310 is a good overall tower server. It's a little more expensive than the TS140 from Lenovo, at around £430, but its upgrade options are roughly on a par with the Lenovo entry. The added benefit out of the box is the dual gigabit Ethernet ports, the increased number of external USB 3.0 ports and the added USB 3.0 port located on the motherboard for

the backup option. Although there's a good chance you'll never use the internal USB port, it's a nice finishing touch and goes to show there's been some thought put in by Fujitsu.

This is an entry-level server, ideal for small offices and workgroups or individual solutions. The user though may instead opt for the slightly cheaper and quieter Lenovo TS140. In the end, it's purely down to the name you trust or who you're used to dealing with.



#### **Tower Servers**

### Dell PowerEdge T110 II

# • Price: £480 • Manufacturer: Dell • Website: goo.gl/Ed6Y2X • Required spec: Server software, Linux or Windows (licence needed)

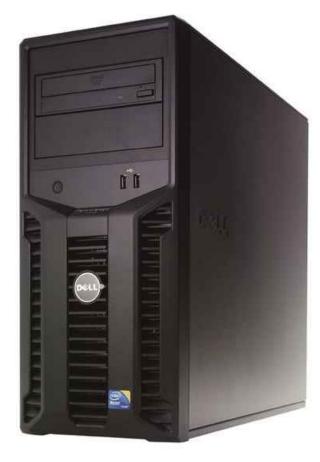
ou'd be hard-pressed to find a server room anywhere the world that doesn't have a Dell server in it. Even the most ardent IBM and HP followers will more than likely have something from the Dell product range stuffed into a corner. Such is the legacy of the company's products in terms of stability, affordability and familiarity.

The Dell PowerEdge T110 II is the entry-level model in the PowerEdge range, which caters for anything from a small businesses through to some of the pretty complex setups that a global multi-national would no doubt specify.

It's a standard affair Dell tower server, measuring 463 x 189 x 420mm and weighing in the region of 14.5kg. The specification of our particular model came with a single Intel Xeon E3-1220 V2 3.1GHz processor, 4GB DDR3 memory and a single 1TB hard drive, which was OS free leaving us to install Ubuntu Server 14.04.2 LTS.

Rear IO connectivity isn't the best we've ever seen, there are four USB 2.0 ports, eSATA, VGA, serial and a single gigabit Ethernet port. Obviously you can add to that depending on the options you pick from the Dell site, but for the base tower spec, this is your lot.

Internally, the motherboard has four memory slots for a total of 32GB DDR3 RAM,



▲ There's not a server room in the world without one of these

two PCle x8 slots, a single PCle x4 and a single PCle x1 slot. There are five SATA connectors available, but most options for the T110 II include adding a PERC RAID controller. Nevertheless, you'll able to RAID any connected drives to 0, 1 or 10.

The PowerEdge T110 II may appear to be a little bland and very minimalistic in its base specification. Naturally, Dell would want you to include a lot more in the configuration stages. As it is, the server is designed for very lightweight duties – no more than a room full of users being connected, for example.

The advantage of using a Dell server, though, is the amount of support you'll have for different operating systems. Dell has

taken great steps in making sure that the PowerEdge range is compatible with both Microsoft's server systems as well as Linux, in particular SUSE and Red Hat certifications. We, though, didn't find any issues with the Ubuntu Server version we were running.

Despite the fact that connectivity is lacking a bit, the Dell PowerEdge T110 II is a pretty solid foundation to build on. It's stable, fairly quiet, although again not as quiet as the first server we reviewed. It's an ideal starter server; there's plenty of expansion and if you take the Dell route then you'll have countless choices to upgrade and add components to boost connectivity or performance.

The price is a bit of a sticking point, however. The model



▲ The Dell PowerEdge T110 II is good, but expensive for what you get

we had costs in the region of £480, which is fairly expensive considering you don't get a huge amount for your money. As you add more options through the Dell site, though, the price can rapidly rise into the thousands.

This is a good starter server, but one that's lacking in some connectivity and which can get expensive very quickly. On the plus side it's a Dell server, so it'll work with near any OS installation and it's easy to upgrade and maintain.





### HP ProLiant ML150 Gen9 E5-2603v3

#### DETAILS

- Price: £1.056
- Manufacturer: HP
- Website:
- goo.gl/b03E8j
- Required spec:
- Server software, Linux or Windows (licence

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he HP ProLiant ML150
Gen9 line of servers
come in a bewildering
range of serial numbers
and options. For example,
the ML150 Gen9 E5-2620v3
8GB H240 is considered as
the baseline entry-level server,
whereas the ML150 Gen9
E5-2620v3 16GB H240 Hot
Plug is the top level offering. It
gets confusing, since they are
essentially the same base but
with different options added.

Nevertheless, the one we have on test is the ProLiant ML150 Gen9 E5-2603v3 4GB B140i. A bit of a mouthful, but one that comes with a six-core Intel Xeon E5-2603 v3 processor at 1.6GHz, 4GB of RDIMM memory and a single 500GB hard drive, which again is OS free.



▲ The ProLiant ML150 Gen9 is an impressive server, at an equally impressive price



▲ We only dream of filling one of these up with two CPUs and 256GB of memory

The connectivity, much like the Dell PowerEdge, is a little bleak around the back of the machine. You'll find VGA, two USB 3.0 and two USB 2.0 ports and a pair of gigabit Ethernet ports. The front of the chassis though is where it begins to get a little busier. By removing the front of the case you'll reveal the hot-swap drive area. This is where you can plug in up to eight drives of varying capacities into the HP Dynamic Smart Array, with every conceivable RAID option available.

Furthermore, the motherboard itself can support dual CPUs, 16 DDR4 slots (two banks of four, eight per processor, each side of the CPU sockets), six PCIe slots of varying speeds and a micro-SD slot on board. The total amount of memory that can be fitted into the ML150 Gen9 is 256GB, and the maximum storage options can top 30TB plus.

It's quite an impressive thing to behold, especially from the point of view of the average home user. However, as you can assume then, this isn't your ordinary entry-level server. Whereas the other servers we've tested so far had some good expandability, the potential in the ML150 Gen9 could run a very large organisation without any hint of a problem. Mind you, it'll also run into the tens of thousands to do it.

The base model we tested cost £1,056. Once you start to add more HP branded options, such a memory that can cost from £186 to £282 and ML150 compatible cradle hard drives that cost from £311 for a single terabyte to £654 for 3TB, the end cost will soon mount up.

The cost though isn't the only flaw. The noise levels from the ML150 are quite extreme, especially since we've been used to testing some reasonably quiet servers so far. Also due to the extreme expansion support of the ML150 Gen9, it's not the smallest or lightest of servers to

consider for the small office. It measures  $200 \times 620 \times 432$ mm and weighs near 20kg.

That said, it is an extremely capable and powerful server. It is probably too much for the small office to consider, even the base specification, purely because of the size and expense. If you have a use for it in mind, however, and you're serving a lot of users, then this is the one to consider. We can only imagine how well it'll perform with 60TB total storage, 256GB of memory and a pair of 12-core Xeon E5-2650L V3s installed.



#### **Tower Servers**

## **Dell PowerEdge T20 Mini Tower Server**

#### Price: £350 Manufacturer: Dell goo.gl/ocjLhE Required spec: Server software, Linux or Windows (licence needed) ......

e're back with Dell again, specifically another of its PowerEdge models, in fact. This time, however, it is to present something a little different from the rest of the group. The Dell PowerEdge T20 Mini Tower Server is, as the name states, a more compact server designed for small businesses that want their own servers without having to dedicate a portion of the building as a server room.

As with the other Dell Servers available, there's a range of options and extras. Our model, however, came with an Intel Xeon E3-1225 v3 3.2GHz quad core processor, 4GB of DDR3 memory and a 1TB hard drive on to which we installed Ubuntu Server 14.04.2 LTS.

Despite it's ambition to be compact, the rear IO connectivity is really quite good in this case. You'll find a pair of PS/2 ports, single gigabit Ethernet, two USB 3.0 ports, four USB 2.0 ports, VGA, two DisplayPorts and a serial port. Inside the motherboard features two PCIe x16 slots, a PCIe x1 slot and a standard PCI slot. There are four memory slots for a maximum of 32GB and four SATA connections with a few software RAID options available.

The T20 measures 360 x 175 x 435mm and weighs just 12kg, which will make fitting



▲ The Dell T20 Mini Server is a decent, low cost option

into a smaller office space a lot easier than any other model here. Speaking of which, it's also the quietest server we've had running so far, even more so than the first server on

In truth there's not much difference between this server upgrade potential is roughly the same, and the connectivity

and an ordinary PC. The isn't too far different either. Windows Server and marketed it slightly differently.

We were quite surprised by the lack of options available for the T20. There are a few, as we mentioned at the beginning of the review, but there doesn't seem to be anything that makes this model stand out from the crowd. This means that unless you know how to upgrade and what components to upgrade in the future, you're left with the limited selection from Dell.

For just £350 it's a good deal and a good server for sharing or individual use. But we're fairly sure you could adapt a 'standard' PC for less and one that's a bit more powerful as well. That said, our version of Ubuntu Server worked well and we can appreciate the need for a smaller footprint server.

On the whole it's a good, low cost server, and it'll probably fit in well with the busy office where there's little to no IT support. We can't help thinking, though, that there are far better options available without having to go down the Dell PowerEdge Server route.



test, the Lenovo TS140. With that in mind then, it's easy enough to picture the T20 as an server that's placed under a desk, much like an ordinary workstation, rather than needing an office move-around. In fact, you begin to wonder why Dell bothered with a mini server such as this to begin with, when they could have simply dropped the cost of one of their workstation models and offered it with a copy of





### Lenovo System x3100 M5

- Price: £950
- Manufacturer:
- Lenovo
   Website:
- goo.gl/SJyTN9
- Required spec:
- Server software, Linux or Windows (licence needed)

....

e're back with a Lenovo product for the final review of the group, but the System X wasn't always a part of the Lenovo stable. When the company acquired the IBM x86 portfolio a way back, it also managed to get its hands on the original IBM System X, a tower server range that's ideally suited for smaller businesses and remote environments, as well as small workgroup and individual solutions.

There are currently four servers in the System X line-up, with the x3100 M5 being the entry-level option. Don't let that fool you into thinking it's lacking though, as this server can pack quite a punch when properly configured.

The model we have to test has an Intel Xeon E3-1220 v3 quad core 3.1GHz processor, 8GB UDIMM memory and a single 1TB hard drive onto which we installed Ubuntu Server 14.04.2 LTS. The rear IO ports are pretty thin on the ground, consisting of a VGA port, serial port, four USB 2.0 ports and a pair of gigabit Ethernet ports.

The motherboard has four DDR3 memory slots that can take a maximum of 32GB worth of RAM, two PCIe x16 slots, PCIe x1 slot and a standard PCI slot. There are also six SATA ports for the four drive bays and two media bays, which can be configured for a hardware RAID

0, 1, 5 or 10. Finally, the x3100 comes with a 430W 80 Plus Silver rated redundant power supply in addition to the 350W main PSU.

There's plenty of space to grow with the x3100. Upgrading is a fairly easy process, as the components can be of the off the shelf variety and not limited to anything branded. It's a pity there's not much more on offer from the rear IO, the front of case does have a pair of USB 3.0 ports, but it's often easier to have the wealth of connectivity at the rear of the machine. Still, there are enough PCIe slots to insert more graphics options or some other connection if needed.

Apparently there are two models of the System x3100 available. One is a more compact version, without the redundant PSU and lacking a few hot swap drive bays, and the other is the one we



▲ ... But there are more cost effective solutions available

were reviewing. We're not sure of the measurements of the compact version, but the one we had measured 439 x 217 x 569mm and weighed an impressive 20kg. Not something you can hide away or balance on top of that wobbly rack you've been meaning to tighten up.

The Lenovo System x3100 M5 isn't a bad server. It's got upgrade potential, it's stable, and it's fairly quiet. The only problem is that it's fairly expensive for what you get. Our model cost a cool £950, which is probably a little too much for a small company to pay for the base specification.

Although it's good, then, we think Lenovo has a better and more cost effective solution in the form of the TS140.





▲ The Lenovo System X3100 is certainly a good all-rounder...



We thought the Lenovo ThinkServer TS140 had the best offering of cost versus performance. It's a good all-round server and one that both a new company and larger workgroups can get good use out of.



#### Dell PowerEdge T20 Mini Tower

The Dell PowerEdge T20 Mini Tower Server may not be much better specified than that of a normal desktop PC, but the fact is that it's ideal for a small company or one without access to IT staff.

#### **How We Tested**

Each server had Ubuntu Server 14.04.2 LTS installed and was connected to a gigabit network, with a selection of folders shared for individual users.

	Lenovo ThinkServer TS140	Fujitsu Primergy TX1310 M1	Dell PowerEdge T110 II	HP ProLiant ML150 Gen9	Dell PowerEdge T20 Mini Tower	Lenovo System x3100 M5
Price	£390	£430	£480	£1,056	£350	£950
СРИ	Intel Xeon E3-1226 v3 3.3GHz	Intel Xeon E3-1226 v3 3.3GHz	Intel Xeon E3-1220 v2 3.1GHz	Intel Xeon E5-2603 v3 1.6GHz	Intel Xeon E3-1225 v3 3.2GHz	Intel Xeon 3-1220 v3 3.1GHz
Memory	4GB	8GB	4GB	4GB	4GB	8GB
HDD Installed	1TB HDD	2x 500GB HDD	1TB HDD	500GB HDD	1TB HDD	1TB HDD
Max No CPUs	1	1	1	2	1	1
Max RAM	32GB	32GB	32GB	256GB	32GB	32GB
Max No Drives	Five	Six	Five	Eight	Four	Six
No. Network Ports	1x gigabit Ethernet	4x gigabit Ethernet	1x gigabit Ethernet	2x gigabit Ethernet	1x gigabit Ethernet	2x gigabit Ethernet
Dimensions (mm)	174 x 425 x 430	175 x 419 x 395	189 x 420 x 463	200 x 620 x 432	360 x 175 x 43	439 x 217 x 569
Weight	11kg	14kg	14.5kg	19.8kg	12kg	20.1kg

#### REMEMBERING...

# Remembering... Commodore 64

#### A monumental 8-bit computer this week

he school yards of the early 80s were home to such gaming wonders as British Bulldog, Manhunt and Conkers, but above all else, they were the battleground for who preferred the Spectrum over the Commodore.

To the Spectrum owners, the C64 was a toilet-coloured, uninspiring box that produced blocky graphics and was purchased by parents who had more money than sense. The truth, though, was something else. In fact, the C64 (however much I hate to admit it) was a far more competent and technologically advanced machine than its 80s 8-bit rival.

Full-colour sprites and hardware scrolling, thanks to the VIC-II chip, extra memory and a better keyboard than the rubber keys on offer on the Speccy were just the tip of the iceberg. The pièce de résistance, of course, was the utterly amazing three-channel SID chip that produced some of the most impressive soundtracks and effects outside of the arcades.

Many of the games that appeared on the C64 were technically so far ahead of their time that even Commodore itself was amazed at what the coders of the time were getting the machine to do. Take *Uridium*, for example. Here was a game that featured 50Hz, multi-layer parallax scrolling and smooth-as-silk hardware sprites that drove forward in varying attack patterns. Although the Spectrum port was just as iconic and an incredible achievement, it simply didn't look anywhere near as good as the original C64 version.

#### **Its History**

Commodore had already seen much success in the business market and with the C64's predecessor, the VIC-20. Early 1981, it began work on developing the next generation of entertainment components based on what was available in the arcades.

The results of that work were the aforementioned VIC-II graphics chip and the Sound Interface Device chip (SID). These were to be fitted into a games console apparently called The Ultimax, which was cancelled after just a number of units. However, Commodore engineers Robert Russel, Robert Yannes Charles Winterble and Al Charpentier managed to pitch an idea for a follow-up machine to the VIC-20 to Commodore boss, Jack Tramiel.

The VIC-40, as it was then known, went through many design alterations until it was finally agreed on that it should resemble the VIC-20 to continue the available Commodore range, including the business machines. By the time it was released to the eager press in January 1982, the name was changed to C64.

The C64 soon became the highest selling single computer of all time, despite the fact that it cost £399 when it was released to the UK public. Its legacy to this day is still as strong as that of the Spectrum's and probably will be for many more years yet to come.

#### **The Good**

Often far better graphics then the Spectrum and naturally the untouchable audio from the SID chip, which is still going strong.

#### The Bad

Expensive, very expensive. A serial port for IO and the famously dodgy 1541 disk drive. You have to admit that typing Load"" was better than typing Load"\*",8,1.

#### Conclusion

The Commodore 64 was a singularly impressive home computer. Although I only owned one for a few months before upgrading to an Atari ST, the C64 still sticks in my mind as the computer I would have liked to have known better.

So which one were you: a Spectrum owner or a C64 owner?

#### Did You Know?

- There were an estimated 17 million C64s sold in its lifetime.
- You could run an Apple-1 emulator on a C64.
- The C64 BASIC was pretty much a series of pokes.
- One of the early Anarchist's Cookbooks was how to hack with a modem and a C64.



▲ C64 BASIC or PET BASIC if you prefer



▲ Zak McKracken and the Alien Mindbenders, one of the greatest ever C64 games

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# MICROSOFT RESEARCH

## **3D Vision And Augmented Reality**

## **David Briddock** seeks out the roots of Microsoft's holographic and HoloLens technology

n this series we're uncovering some of the most interesting and innovative technology projects from Microsoft Research lab teams across the globe. This time the theme is Microsoft's investigations into three-dimensional vision technology, including the recently revealed augmented reality and holographic initiatives.

#### **Interactive 3D Technologies**

The Interactive 3D technologies (I3D) team has an impressively diverse research scope, which includes 3D graphics, computer vision, novel hardware, machine learning (ML), augmented reality (AR) and natural user interfaces (NUI). However, the main focus of these activities is clear: to envision and demonstrate radically new user experiences that incorporate state-of-the-art vision/graphics algorithms, deployed on advanced display and sensor hardware.

One of the key words here is 'demonstrate', so rather than just write papers on theory, algorithms and techniques, each project has a high practical content. This ensures the physical and engineering problems associated with building complex systems are confronted, addressed and resolved.

As you'll also see from the website (**goo.gl/ a2CS77**), there are many ongoing projects, but here's a sample of the higher profile activities.

#### **I3D Projects**

The 'Ultimate IO' project explores how the camera might be improved to capture reality. The scope includes the acquisition of 3D geometry, material characteristics, subtle light fields and other novel display technologies that help deliver rich digital content visualisations.

The 'Reality Remixed' project was conceived to tackle the most difficult technical and user interface challenges associated with the

field of augmented reality (AR). In particular, the team investigate real-time tracking and reconstruction, augmented reality hardware and devices, plus rich user experiences that blur the physical and digital worlds.

Under the theme of 'Recovering and Understanding Reality', a team explores the software side of virtual reality. Their efforts have resulted in probabilistic models and algorithms that can be used to infer physical properties of the scene, such as scene composition, object recognition, material surfaces and lighting.

Also software based, the 'deForm' project explores new algorithms that can digitally represent the dynamic nature of real-world objects. The challenge is to cope with the movement and deformation of all kinds of artefacts. This includes real-time hand poses, along with facial expression capture and classification.

However, one I3D project in particular has recently acquired a high level of publicity. At January's Windows 10 'The Next Chapter' event, the on-stage presenters demonstrated an early prototype of the I3D team's HoloLens headset.

To deliver a fully working, productionquality HoloLens, the I3D team and associated contributors worked closely with Microsoft's Product Group members.

Eager for feedback, a HoloLens prototype unit is currently being put through its paces by Nasa, which is using it to better visualise the scientific data and images returned by the robotic Mars Rovers. That in turn will help them to plan future routes, observation sites and drilling activities.

Does I3D sound like an exciting place to work? If it does, you might be interested to know Microsoft is still recruiting I3D team members, including researchers, postdocs,



▲ IllumiRoom in action

#### MICROSOFT RESEARCH



▲ RoomAlive procam unit

interns and so on, so visit the website (**goo**. **gl/a2CS77**) to see how to apply.

#### **IllumiRoom**

IllumiRoom is a Microsoft Research proofof-concept system to augment the area surrounding a TV screen. These manifest themselves as peripheral projected visualisations to create a wall-sized entertainment experience, regardless of the TV screen's physical dimensions.

In operation, IllumiRoom (goo.gl/ZkXZSE) combines a Kinect for Windows camera system, a wide-angle projector and clever software to blur the lines between on-screen content and the surrounding environment.

The Kinect-captured room appearance and geometry is overlaid by projected images, which are merged and synced with the TV screen content. The effect is to seamlessly mix the virtual and physical worlds in real time, extending the field of view and delivering entirely new game experiences.

Microsoft has released a demonstration video (**goo.gl/jrbkJV**) showing live, unedited images of the IllumiRoom system in action.

#### **RoomAlive**

While still at the proof-of-concept stage, the RoomAlive (**goo.gl/gjcZuV**) project team think their prototype system offers a glimpse into the future of interactive gaming. In essence, the team are trying to answer the question "What new gaming experiences can technology deliver in the next few years?"

RoomAlive transforms any room into an immersive, augmented entertainment experience through the use of video projection. Participants touch, shoot, stomp, dodge and steer though projected content, which seamlessly coexists with the surrounding physical environment.

To do this, RoomAlive builds heavily on the IllumiRoom research project (described above). IllumiRoom is largely focused on extending traditional gaming experiences out of the TV

#### **Holographic Foundations**

Do you have a distinct feeling you've seen something like IllumiRoom, RoomAlive and Surface Computing technology before? Well, you might be right.

As part of its January 2015 Windows 10 'The Next Chapter' event (news.microsoft.com/ windows10story), Microsoft revealed some of its holographic initiatives.

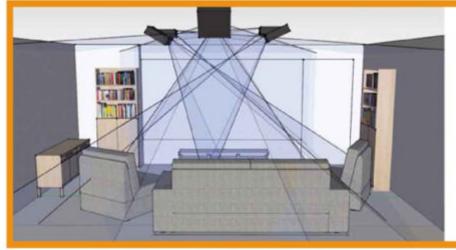
Apart from a promised blendedaugmented-reality HoloLens headset and high-resolution 88" Holo Studio monitor, there was a video showing a living room filled with 3D images, which were projection mapped onto walls and furniture, and which were produced by IllumiRoom, RoomAlive and Surface Computing technology.

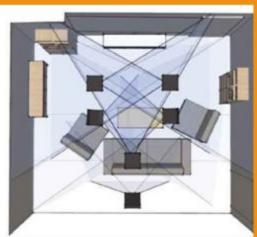
Watching the video, you become acutely aware how holographic technology presented at the event relied heavily on the work done by the Microsoft Research project teams, which themselves rely on critical foundation work carried out by other Research teams and in collaboration with universities around the globe.

display. However, RoomAlive focuses on gamer interaction and the sort of games that will be possible with interactive projection mapping.

At its heart, RoomAlive has a projector depth-camera unit, known as a procam. Each procam unit is a blend of a low-cost commodity wide field of view projector, a Microsoft Kinect sensor and a computer. The projector handles the display rendering, while the Kinect is used for tracking.

A single procam unit would deliver an IllumiRoom-style experience, but RoomAlive has six procam units. This means





▲ RoomAlive projection mapping



▲ MirageBlocks

it can animate every square inch of your living room, using a technique known as projection mapping, which transforms each wall and every item of furniture into an interactive display.

Each procam unit is auto-calibrating and self-localising. This means they can be installed in whatever location is most appropriate. This kind of flexibility helps increase its potential, especially when considering home-based environments.

Most importantly, RoomAlive game designers can create projection mapped games without knowledge of a room's specific dimensions, shape or colour scheme. Instead, RoomAlive automatically detects floors, walls and objects, and content is rendered in real-time, dynamically adapting to the room's colour and geometry.

In order to work in a realistic manner, 3D images must be displayed with the correct perspective. RoomAlive tracks the player's head position relative to the room (across all six procam units) and renders a view-dependent projection, so RoomAlive content always looks correct as the player moves their head around.

#### Kinect v2

The latest Kinect colour camera sensor is now 1080p compatible. What this means in practice is that it has up to three times the fidelity of the previous version, resulting in significant improvements in small object visualisation accuracy.

The new sensor is supported by the Kinect for Windows software development kit (SDK) 2.0, which provides developers with drivers, tools, APIs, device interfaces and code samples (goo.gl/7U2QPf). Version 2.0 offers more stable body tracking in general and is capable of tracking as many as six people at a time, plus 25 individual joints per person.

To see for yourself what RoomAlive could do in a typical living room setting, take a look at this video: **goo.gl/5FBLwr**.

#### **3D Surface Computing**

Another 3D virtual worlds theme project, Surface Computing is all about creating naturalistic 'in-the-air' interactions.

Why in the air? Well, when objects are bound to a surface, it poses a fundamental limitation in the way they can be manipulated in the third dimension. To overcome this restriction, the team devised a novel solution that creates a continuous interaction space, both on and above a surface, so a user can simply pick up an object off the surface and then manipulate its position in 3D, just as if it were a real object.

Although this description sounds straightforward, the realisation of this concept involves lots of sophisticated technology. Apart from an augmented reality headset, there are switchable diffusers, infrared illumination, IR-based depth estimation, holographic projection screens, a depth-sensing camera and masses of sophisticated software.

And if you watched or read about the HoloLens headset demonstration at the Windows 10 'The Next Chapter' event video (goo.gl/DcCPe5), you'll know this technology exciting both attendees and the media press in general.

However, you don't have to own an augmented reality headset. This system also

works with an updated version of Microsoft's multi-touch tabletop prototype (confusingly named Surface), as demonstrated by Bill Gates way back a 2007.

The latest incarnation is called 'SecondLight'. In this version, secondary content is projected through the display, via two separate projectors, as well as an 'in-theair' interaction sensor system to capture user gestures and manipulate objects held above the surface.

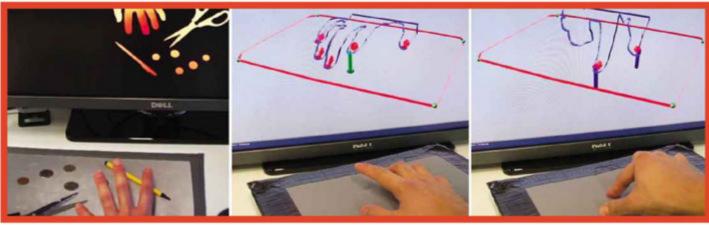
A couple of supporting monitors are hooked up to the unit so observers surrounding the tabletop can see what's actually being outputted by each projector.

Real-world scenarios include the visualisation and manipulation of 3D medical data, produced by MRI scanners and similar machines.

#### **HoloDesk**

HoloDesk is a novel interactive system combining an optical see-through panel and Kinect camera to create the illusion that users are directly interacting with 3D graphics (goo.gl/KZE4Qe). One of its most important characteristics is that a HoloDesk user doesn't have to own or wear any specialised hardware or input device. Instead a virtual 3D scene is rendered through the beam-splitter panel (essentially a half-silvered mirror), which combines the virtual world with the real-world.

This technique creates an interaction arena. Virtual 3D objects can be displayed in this



▲ RetroDepth



▲ MoViBing

arena, while hands placed inside can grasp and manipulate these 3D objects.

The project vide, in which someone selects and jiggles spheres and cubes, looks quite impressive (**goo.gl/CyIsZV**). The same video also covers the display, beam-splitter panel and camera setup. It also hints at other possible applications, such as face and particle tracking or interaction with various real-world physical objects.

#### **MirageBlocks**

MirageBlocks is a research project (**goo**. **gl/37YggG**) that employs 3D stereo projection combined with Microsoft's Kinect v2 camera (see boxout) to capture, display and interact with digital renditions of 3D objects.

With MirageBlocks, everyday physical 3D objects are rapidly digitised. A user then interacts with this digital representation using only hand and finger gestures.

The project team have already demonstrated a simple modelling application, where a complex 3D model is constructed with just a few wooden blocks. Here each block is individually digitised and assembled.

To operate MirageBlocks, you'll need to wear 3D shutter-style glasses, but the same setup can also be used for telepresence applications, where real items from the remote setting are digitised and projected as virtual 3D objects in your own virtual world.

#### **Retro Depth**

RetroDepth is an advanced yet low-cost vision-based system able to accurately sense the 3D silhouettes of hands, styluses and other objects (goo.gl/e5GesJ).

The system elements include two infrared cameras, diffuse infrared LEDs and

a mat covered in an off-the-shelf retroreflective material. This material aids image segmentation by creating a strong contrast between the surface and the object of interest.

The RetroDepth system captures highprecision input from items placed directly on or in motion above the mat. To do this the system's software includes a highly efficient stereo-matching algorithm to precisely estimate the object's 3D contours. These contours are tracked in real-time across three dimensions.

What does this mean in practice? Take your hand for, example. The movement of each finger and the precise location of each finger tip can be captured, so it's possible to perform complex gesture recognition, including pressure sensitivity. For a stylus-type object, the tip's position and physical stylus angle can be continuously tracked.

#### **MoViBing**

Today, owning a mobile phone means owning a device capable of image and video capture. In many cases, the image quality is at least as good as the instant film cameras of yesteryear. And because we'll always have our mobile phone to hand, this has caused a huge rise in the number of photos we snap and videos we capture.

However, this deluge of digital data has created a few problems – in particular, the ability to associate searchable textual information with an image or video segment. Of course, these days our digital image collections can be flicked though quite rapidly. However, typically a video needs to be watched in full to determine its content or even discover the subject category.

As we all know, entering text on a mobile phone can be a tedious and error-prone

activity. It's such a contrast to the snap-and-go image capture process.

The MoViBing project team (**goo.gl/ DdMNp8**) aim to help by automatically generating video tag suggestions in real-time and in multiple languages. This tag data is stored alongside the video file to simplify subsequent access and management.

The user can quickly scan these tags and keep the most appropriate ones, while marking the others for deletion. The remaining tags provide an always-available searchable medium, and the same tag data can act as a starting point for Bing or Google searches. mm

#### Links

- Interactive 3D: goo.gl/a2CS77
- IllumiRoom: goo.gl/ZkXZSE
- IllumiRoom video: https://m.youtube.com/ watch?v=re1EatGRV0w
- RoomAlive: goo.gl/gjcZuV
- RoomAlive video: goo.gl/5FBLwr
- **HoloDesk:** goo.gl/KZE4Qe
- MirageBlocks: goo.gl/37YggG
- MirageBlocks video: http:// research.microsoft.com/apps/ video/default.aspx?id=146001
- RetroDepth: goo.gl/e5GesJ
- RetroDepth video: https://m. youtube.com/watch?v=96CZ\_ QPBx0s
- MoViBing: goo.gl/DdMNp8
- Windows 10 Story: goo.gl/ DcCPe5
- **Kinect Windows SDK**: goo. gl/7U2QPf



Pretending they're in America so they can stream certain content has become the *modus operandi* for computer users around the globe. **Rob** investigates the legal issues of region hopping

nyone who regularly watches TV shows, films or other videos online will have come across the words 'We're sorry, but this video has not been made available in your region' before. It can be infuriating to be denied access to content, especially in a world where many of us have access to hundreds of TV channels via Freeview, can access most pop music free-of-charge through Spotify, and/or use services like iPlayer to access a library of free film and television content at the click of a button.

Resultantly, many of us have probably thought something along these lines: 'if it's truly a world wide web, isn't restricting access by our geographical location a tad archaic?'

Well, on first thought, it certainly does seem that way. Beneath the initial question, though, lies a murky legal debate. We did some digging to try and get to the crux of the issue.

#### **Bending The Rules**

VPNs (virtual private networks) have supplied one solution to this problem. You may use a VPN at work – a shared system where you and your colleagues store files. Indeed, you may even have one in your home. How is this relevant to region-locked videos, though? Well, a similar system of shared access has been used by several app developers to offer their customers a way around those irritating 'not available in your region' messages.

Chief among the providers of this service is probably Hola, an app you've almost certainly heard of, or possibly even use on a regular basis yourself. Ofer Vilenski, the CEO of Hola, told *Micro Mart* that his company are "a P2P network for anonymity – a sort of extension to Google's "incognito mode", where we also help to keep your IP random."

Translated into layman's terms, that essentially means that Hola helps its users to keep their location private from the websites they frequent. This is achieved through a shared peer-to-peer network where everyone who downloads the free version of the app makes his or her IP address free for borrowing.

As a result, you can pretend to be in the USA by temporarily using an American IP address, and can gain access to all sorts of otherwise blocked content through the process. Unless you're willing to pay for the premium service, someone on the other side of the Atlantic is probably borrowing your IP address at the same time. After all, there are programmes on British Netflix that aren't on the American equivalent, too.

According to Softonic, Hola Better Internet is the third most-downloaded browser add-on in the UK, after Facebook Messenger and AdBlock Plus. Worldwide, over 44 million users have downloaded a version of Hola since its launch in 2008.

Taken at face value, then, the services of Hola seem like a popular and ideal solution to those pesky region-based annoyances that the internet likes to throw at us. However, not everyone is a fan of the idea.

#### **Trying To Shut It Out**

Hulu (not to be confused with Hola, guys, those vowels are important) is an online company based in America. It offers a wide selection of television and film content, from cartoons to indie flicks, to sports documentaries and blockbusters. In the US, a lot of its library is available for free. You can pay to get shows quicker and in higher definition, if you like.

In the UK, though, the entire service is unavailable. Like American TV channels, Hulu only has the rights to screen its content in the USA and its territories. Well, that was the case until they branched out into Japan in 2013, at least. The rules remain the same though – they only have the rights to distribute content in those countries, not anywhere else. Therefore, to

cheat your way on to its service certainly breaking a few rules. It breaches the legally binding terms and conditions, too.

In 2009, Hulu attempted to launch a service in the UK and Ireland, but discussions with major British broadcasters apparently broke down before the project could come to fruition. Legally, then, its library simply isn't meant for Britons.

In April 2014, Hulu took a strict stance against locatingshifting internet users. Hulu publically announced that they were cutting access for visitors of their site who were using anonymous proxy servers that hide users true locations:

"A proxy server works as sort of a middleman between a personal computer and the Internet," the announcement explained. "In practice, anonymous proxies are used to hide information about a person's personal computer so they can browse the web anonymously – and sometimes access a site that is restricted to a certain geography."

"Due to contractual limitations, Hulu is unable to stream videos to users of anonymous proxy servers because of possible geographical limitations," it was clarified. "If our system determines that your computer is behind an anonymous proxy, you will need to disable it before you can access videos on Hulu again."

# Hola Better Internet is the third most-downloaded browser add-on in the UK, after Facebook Messenger and AdBlock Plus

There were complaints at the time that this decision would affect American citizens who relied on VPNs to access the service. Military personnel, particularly those serving abroad, were popular examples of those whose viewing patterns would be damaged by the decision.

This was hardly a perfect fix, and, to this day, users of Hola can still technically access Hulu using the services provided by the region-hopping specialists (even though Hola's T&Cs urge you not to breach anyone else's T&Cs). Hulu's crackdown affected a few known proxy server users, but the sheer range of shared peer-to-peer VPNs utilised by Hola were impossible to shut out, it would seem.

#### **Punishing The Customer**

So, if technological attempts have failed to crack down on those who circumvent terms and conditions of streaming websites via borrowed VPNs, what other options are there? One idea is to punish the customers. It might sound drastic, but this process is currently being considered.

Netflix – arguably the best-known online content provider – has some specific notes in its terms and conditions that attempt to cut down on those who are using VPNs to access content made available to other countries. The company, which announced profits of \$83.4 million in the last quarter of 2014, has this stipulation in its contract:

"The content that may be available to watch will vary by geographic location. Netflix will use technologies to verify your geographic location," the Netflix Terms of Use state. And later on: "we may terminate or restrict your use of our service, without compensation or notice, if you are, or if we suspect that you are, (i) in violation of any of these terms of use or (ii) engaged in illegal or improper use of the service."



Although there's little proof that this rule is enforced all that much, further announcements have confirmed that it is a 'violation of terms' to use to a VPN to access the Netflix library of another country or territory. Again, content licensing restrictions are the problem here. For varying reasons, distributors of films and television shows are rarely willing (or perhaps, able) to sell a package allowing unrestricted global access to their content.

A Netflix representative told *The Independent*, "by way of background, what we do is nothing different than what traditional TV networks do to prevent, for example, someone from outside the US watching the Olympics on NBC.com.

# Why isn't more content globally available in a legal way, if it's so easy to cheat the system?

"Further background: We are working to become a global internet TV network and, as part of that, will have more global rights to series, features, docs, comedy specials, etc. This should make this whole issue moot over time."

Arguably, this is the crux of the issue. In this day and age, there are enough internet masterminds in play that, even if Netflix and Hulu could shut down the likes of Hola, another 'workaround' would probably present itself to avid online streaming fans in a matter of minutes.

Either way, the problem would remain: why isn't more content globally available in a legal way, if it's so easy to cheat the system? Millions of customers are willing to pay subscription fees to the likes of Hulu, Netflix and HBO (which has also waded into the argument over recent months), but why should the access to the movies and TV shows that they love be determined by their address in this day and age? Are we not a global community online?

#### **Coming To A Head**

More and more, viewers are expecting to have access to their entertainment of choice at the same time as everybody else. However, in many cases, the entertainment industry is clinging to the idea of regional distribution rights which divide up the globe for their convenience. Therefore, you end up with every single



episode of *Friends* being available on American Netflix, and nothing of the sort on the English version. Both Hulu's attempted crackdown and Netflix's threats to shut down accounts both point to one fact: online streaming services are trying to respect their region-based deals with distributors, despite the fact that bypassing the relevant border via a VPN has never been easier.

This makes perfect sense, from a business standpoint, considering that these deals with distributors are surely lucrative contracts for the companies involved. We can see this in how things have come to a head in Australia. There, the government is now considering passing a bill that would make using VPNs to access foreign streams and bypass regional copyright laws a criminal offence. The bill under consideration states that "copyright owners would be able to apply directly to the Federal Court for an injunction to disable access to an infringing online location... The injunction power would only apply to online locations operated outside Australia."

Essentially, this means that if you're in Australia, and using a VPN to access content meant for audiences outside of Australia, the copyright owners could ask the government for permission to shut your connection down altogether. Again, the idea here seems to be in favour of supporting the copyright owners (as in, the owners and distributors) at the same time as restricting the library available to the individual viewers.

The reason Australia is considered such a hotbed for VPN usage? That'd be because only 18 of the 100 most popular shows on American Netflix are available on the Australian version. These customers are paying the same amount, should they really be denied access to the likes of *Breaking Bad*, *Sherlock* and *Twin Peaks*? The service can explain away such anomalies as much as it likes, but it hardly seems fair.

Quite simply, a paying customer utilising an online service is surely entitled the same treatment, regardless of their whereabouts. However, before this can be the case in terms of streaming media, there needs to be some big changes in the way content is distributed before any disparity is likely to change. Netflix, with its aims to broker a global library of content, will hopefully be first to buck the trend. After that, perhaps the rest will follow suit. mm



# System Building Lessons

Which of these do you recognise, we wonder

Attach The Cooler First!

So you've finished putting all the standoffs in place in your brand new PC case, being sure they line up with the holes on your motherboard. Then you've spent a couple of minutes screwing them all in. Excellent. Now, if you haven't already, you simply pop in the processor and attach the... Ah, small problem: you can't fit your cooler, because you need to get to the other side of the board to put the holding bracket in place. And sadly, all the fist shaking and bad language in the world won't change that (and trust us, we'd know).

Whether it's the result of bad design or actual, genuine sadism from manufacturers, many PC cases seem to have an abundance of sharp edges and pointy bits in them – all waiting to slice or impale your precious fingers. Inveterate optimists might shrug off damage to a digit, safe in the knowledge they have another nine to fall back on, but most of us will be rather more alarmed to find blood streaming from our extremities as a result of trying to fit a new graphics card. Also, it's probably not good for the components.

processor looks nice. I'll have that. 16GB of RAM? Yes, please! And I must have that 500GB SSD..." Then you click on the basket total: £6,000! Yep, it's easy to get carried away by all the shiny things, but if you want to build a PC, you'll probably have to accept that you won't be able to get half the stuff you want – unless you're rich, of course, in which case, would you like to be our friend?

Again, this is dependent on whether you're an ordinary person or a millionaire tax exile (our offer of friendship still stands), but for those of us on a budget, it's rarely wise to continue window shopping after you've already bought all the parts for your new computer. Within a matter of days, there could be something newer and better, and/or the thing you just bought could be reduced dramatically in price. You might well curse yourself for not waiting a bit longer, but think like that too much and you'd never buy anything at all.

Anyone who's ever put together a flatpack wardrobe will know there are always bits left over that you simply cannot account for. Sometimes they're spares, but other times you know they're meant to be in there, somewhere. But what can you do, other than pray it doesn't collapse on you the next time you take a shirt out? That logic can undoubtedly be applied to PC builds too, but in this case that leftover screw probably isn't going to cause any problems – not unless it's rattling around inside the case, that is.

You Have To Compromise

They say half the fun of going holiday is planning it, and the same can certainly be said of system building We've all been there, on Ebuyer, Overclockers or whatever, compiling a list of components: "Ooh, that





# Fixing Files

Not all that is corrupt is lost...

s technology marches onwards, we become more and more reliant on hope that data we store long-term will remain in pristine condition. These days, it's entirely possible that everything from your music collection to your holiday snaps to your complete archive of personal correspondence could exist only digitally, with no hard copies available anywhere.

While having data on a computer makes it easy to search, archive and reproduce, it also makes it easy to destroy. Data in digital form is vulnerable, in some ways more vulnerable than when it's stored on paper and other 'analogue' mediums. After all, in what other manner could a single particle of smoke leave your half-finished novel wiped out or inaccessible? Where else can a single scratch mean that all your schoolwork or research material becomes instantly lost to you?

The threat of data corruption hangs over all computer users in some form or another. Most of the time, we're powerless to stop it, but that doesn't mean that you can't give yourself a better chance to survive it, and indeed, even repair some of the damage. Over the next few pages, we'll examine exactly how that's possible.

#### What Is File Corruption?

File corruption can occur for many different reasons, but the main symptom of it is always the same: your operating system's inability to find the data it expects to find. What we mean by 'expects' is a little wooly, but if you imagine the file as book, it could either have an incorrect cover or incorrect contents.

If the 'cover' is wrong, it means there's a problem in the file system. When you try to open a file, your file system (a collection of data about the files on your hard drive) tells the operating system what it should find – a file

of a certain size or type, for example. Corruption in the file system means that this information is wrong. The file doesn't look like it should, and so the OS can't read it.

Yet even if that process occurs without difficulty – which is to say, the file system isn't corrupt – then the file itself could still be. The data in all files is encoded and structured in a specific way so that programs that want to open them know what to do with the information inside.





In most files, you have a header at the start (in the book analogy, this would be the contents page) that tells applications how to understand the contents. Errors anywhere in the file or the header could leave it unreadable, because the two don't match one another – either the contents page is missing or wrong, or the pages it points to are.

Data in digital form is vulnerable, in some ways more vulnerable than when it's stored on paper

To give a simple example, if you open a jpg file in notepad it'll mostly look like gibberish, but you'll see the letters 'JFIF' near the start. This is part of the file header and stands for 'JPEG File Interchange Format'. It essentially tells programs how to turn the 'gibberish' that follows into image data by making it clear what format the data is stored in. If that header is damaged, the program won't know what algorithms to apply to turn the data back into an image, and if the

data is damaged, the application will try to convert it back into an image using the standard method for JFIF files but get no image data in return.

Most corruption affects the larger part of the file system/file header/file data organisation, which is to say the file data – the 'pages' of the book. There are several ways data can become damaged,

but sheer probability means it usually hits the biggest part. File data can be overwritten due to a driver or software mistake, or lost if the hard drive sector it's stored on becomes physically damaged, or accidentally discarded if your computer loses power halfway through moving or copying

the data. A large number of problems occur during saving when the file is being accessed and rewritten (making it highly vulnerable to accidents) but everything from magnetic interference to viral activity can cause corruption to occur.

In some situations, even a small amount of damage can leave render an entire file unusable. Archives especially rely on having the whole file make sense in order to reconstruct compressed data when it gets opened. Some files, such as JPEGs,

can simply interpret junk data as valid, meaning you can easily access the rest of the file and even get a clear idea of how and where in a file data has been lost.

Finally, in some rare cases the file system itself might become corrupt, meaning that the file is intact but inaccessible to normal methods. In these cases the problem can normally be solved by repairing the file system's errors, recovering all data, but only if you act quickly enough.

So if the worst does happen, is there anything you can do?

#### **Diagnosis And Prevention**

Most people might instantly delete a corrupted file once they've realised that its program isn't going to open it any more. That, though, isn't a solution to anything except recovering hard drive space. If the file is corrupt, it's worth trying to figure out why, and most importantly it's worth trying to see how much of it you can recover.

If you discover a corrupt file and there's no obvious cause for it (i.e. you didn't experience a power cut or recently remove a virus) then the most likely cause is damage to the storage medium, and possibly even incoming hardware failure. CDs, DVDs and other types of disc can be scratched, but hard drives and SSDs can spontaneously fail, and that's the thing to look out for.

Hardware failure is serious for a number of reasons, not least because bad drive sectors rarely come along on their own. If one file has become corrupt, others will surely follow as the hardware begins to degrade. In all probability, the first corrupt file you notice isn't the first one to emerge on your system, so you may already have lost data without realising.

For this reason, the first thing you need to do when you find a corrupt file is check the integrity of your hardware. The easiest way to do this is to run a standard Windows disk scan. As well as checking the filesystem for errors, which will hopefully restore any files that are damaged due to damaged metadata rather than actual corruption, a full surface scan of the hardware will reveal any physically damaged ('bad') sectors.



If you don't find bad sectors, then it's good news: the corruption is the result of a software problem, and therefore not indicative of any larger problem. If you do, however, then your hardware is beginning to fail.

At this point the best thing you could do is stop using your system entirely. In all likelihood this would be very impractical, so the next best step is to back up any essential files and order replacement storage ready to transfer the data to new, intact hardware. Until that happens, the more you use your disk the more likely you are to corrupt more files and cause more physical damage, and both of these things increase the likelihood that your data will become unavailable in a complete failure.

Only when you've successfully verified that your hardware is safe to use and/or shored up the data that might be at risk should you attempt to fix any damaged data that you've discovered.

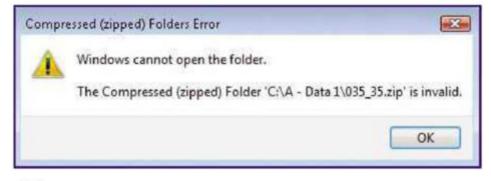
#### **Bypassing/Fixing Corruption**

As we've noted, on a standard Windowsbased PC, file corruption can occur in one of two places: the file itself, or the MFT (Master File Table, also called the File Allocation Table), which tells the disk where files are stored. In both cases, files may become lost or inaccessible, but in the cast of MFT table corruption the vast majority of information will still be there.

Because of the way data is stored, it's likely that a partial form of stored data will always be available with the right tools at hand. In the case of physical damage to something like a hard drive, specialist disk plate readers can be used to retrieve the undamaged disk sectors from physically damaged disk plates. A disk editor – software that directly reads the information on the hard drive, bypassing the file system – can do the same for data that has been logically corrupted without physical damage.

That's specialist-level stuff, however, and more-than-likely to be out of the price range of all but the most desperate user, or a business that's reliant on the data they've lost. Home users might prefer to use a file-reconstruction program, which can scan corrupt data and attempt to extract the valid information by overwriting the corrupt data with something less confusing.

The software may, for example, attempt to reconstruct a file's checksum. When corruption happens on a small



scale – that is, individual bits and bytes being altered – a CRC check will quickly notice this and declare the file invalid. However, it's then possible for software to read the file, use the CRC check to find the errors and then correct them. On a wider scale, the damaged data might be replaced with valid but non-original data, which makes the file valid to be opened and edited once more even if it doesn't bring back the lost data.

If the damage is to the header, recovering the data is even easier: you just need a program which can construct a new header, which isn't difficult at all as

long as you know what type of file has been corrupted. Again, to use the example of a JPEG – as long as you know that the data is supposed to represent a JPEG image, it's a trivial matter for a program to reconstruct the header so that you can view it once more. Some image editors can even do it on the

fly, forcing themselves to interpret data as a JPEG even if the necessary header is currently missing.

It's also possible to rewrite the header to take account for corrupted data elsewhere in a file. Microsoft's WMV format famously took the step of including significant data at the end of a file, which meant that incomplete downloads lacked a full header and would not support the seek function of video players. For this reason, many video editors include a 'repair WMV' function which can write a new header using only the downloaded material as a guide. The video file then becomes seekable, so data that could've been considered lost is now accessible again.

In the event of physical damage to a medium it becomes harder to recover lost data, but there is always the possibility of repair. A scratched DVD might seem unreadable and its data lost, but there are ways in which the disc can be repaired. As long as the damage is purely to the plastic surface of the disc rather than on the data storage layer of it, a simple home-repair kit can be used to take a thin layer of plastic off the disc, eliminating (or at least reducing the severity of) any scratches. The data is then recoverable despite the initial appearance of 'corruption'.

#### **Useful Programs**

Repairing corrupt files is virtually impossible to do manually, but a number of software programs exist that can do their best to repair them. In many

cases data that has been damaged or overwritten can't be brought back, but if the rest of the file can be recovered you might only lose a small amount by comparison. It could mean the difference between rewriting all of your university dissertation and five pages of it – not to be sniffed at!

File Repair (www.filerepair1.com) is a freeware application which can reconstruct and salvage a wide variety of files, including Office documents, archive files, media, images and PDFs. In most cases the corrupt data can't be reconstructed, but the file header can

The only way to be completely immune from this type of failure is to create backups regularly

be rewritten so that any valid data that remains will become accessible once again. It's a relatively simple program – if it can't recognise the format there's no recovery you can do, and likewise if the file is unreadable, inaccessible or too large to analyse then you're out of luck too. But as a free piece of software, it's worth trying out first.

The software Office Recovery (www.officerecovery.com) covers similar

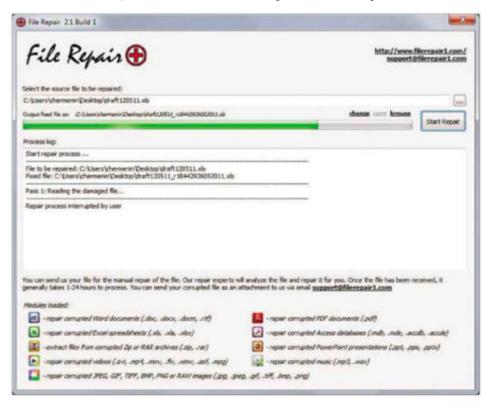
ground, but it's worth noting that it also offers an online version of its toolset, which allows you to upload corrupt data and subject it to meta-analysis to see if your file can be restored. The catch is that recovering your file in such a way is only free if you are willing or able to wait two weeks for the results. A paid version of the service charges \$59 for a 48-hour access to your recovered file, so you've got to weigh up the cost-to-benefit.

Finally, if the problem is with a corrupt storage medium, you can use any number of undelete programs but Piriform's Recuva (www.piriform.com/recuva) is

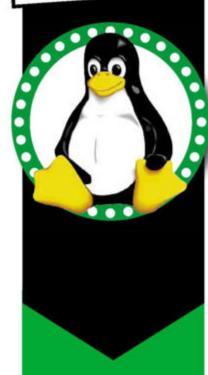
a strong choice. Again, it's freeware, it's able to scan even damaged media in the hope of recovering file fragments, and it can look on both your local drive or removable media to extract damaged files ready for processing by a more sophisticated recovery tool later down the line. Unfortunately,

reconstructing corrupt data is all but impossible in the vast majority of cases. All you can hope to do is salvage what's there and make the best of it.

As ever, the only way to be completely immune from this type of failure is to create backups regularly and often. But if the worst happens and you're caught unaware, hopefully we've given you the tools and knowledge you need to get things back in working order! mm



# Specialists



David Hayward has been using Linux since Red Hat 2.0 in schools, businesses and at home, which either makes him very knowledgeable or a glutton for extreme punishment

# X S S

## **Farewell And Hello**

The sad end of a distro but the beginning of something else

t's always a bit sad to see a distro being shelved. There have been a few distros over the past year that enjoyed a well thought out community filled with like-minded users and as a result they've offered users an alternative place to settle away from the bigger named distros.

Now one of the community favourites is set to close its doors once and for all. Foresight Linux has seen many changes over the years and featured a stable Gnome backbone, where many a user cut their teeth and found Linux for the first time.

Now, or more accurately at the end of May, the Foresight Linux Council has decided to retire this once glorious distro. As Michael Johnson, on behalf of the Foresight Linux Council, states, "The Foresight Linux Council has determined that there has been insufficient volunteer activity to sustain meaningful new development of Foresight Linux."

This is a shame, and it's a sad fact that one of the better Linux projects has had to close down due to a lack of support from the community.

Considering Linux, as a whole,

is a vibrant and very vocal community, it's a pity the volunteers are so hard to find. Surely it wouldn't take much to offer a little time to help keep a project alive? After all, you don't need to be a developer; perhaps there's a way to keep a project alive simply by offering to put together a how-to or to help new users in the distro forum?

Perhaps we need to look at our own favourite distro and consider what we can do to help the team out in the Whichever it is you choose, let's not have another distro retire any time soon. If you use it and you like, then support it.

#### **The \$9 Computer**

Word of the C.H.I.P., the ultrasmall 1GHz computer with 512MB of memory, is reaching fever pitch in certain areas of the internet this week.

No doubt you'll already have all the necessary information related to the C.H.I.P. by now, but if not, then you'll be in for a pleasant surprise as you read

of the better Linux projects

has had to close down 99

future? The best thing to do to begin with is to email the team and see if there's anything they need any help with. You could be more helpful in the distro community and maybe even offer your coding skills to some segment or another to help with the newest release. through its many uses via the Kickstart page at **goo.gl/zVAeJj**.

The \$50,000 goal set by the developers has been blown away to the tune of an impressive \$1.384 million at the time of writing and with just 19 days left to go, at the time of writing, it looks like it'll continue to amount to an even greater number.

The Debian-run C.H.I.P. could well see a new set of hobbyists coming up with innovative ideas that surpass that of the Raspberry Pi. And why not? Isn't the legacy of Linux innovation and creation?

We'll hopefully get hold of one soon, and we'll put it through its paces. Until then, have a think about what you can do with a computer that's smaller than your thumb.

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✓ Farewell, Foresight, and thanks for all you've done

# **Get The Message**

#### Why are bugs so stubborn in current releases of OS X?

n my office, I'm surrounded by screens. I have a slightly aging iMac and a very old Apple flatscreen attached to a newish Mac Mini. Then there's an iPad, an iPhone, a couple of bits of Android kit and the Apple Watch that's permanently glued to my wrist during daytime while I try to figure out what I can actually do with the thing.

With the exception of the Android stuff, which tends to remain blissfully silent, the other screens get terribly excited at varying points during the day. Because I never really know what device I'm going to be using at any given time, they all have important notifications active. And Apple apparently hasn't yet figured out that if I'm typing on my iMac and my iPad is 30 centimetres away, I probably don't need a notification on both, so a message from someone can be like a series of klaxons going off.

The bigger issue, though, is that the messages too often turn into a kind of abstract Burroughsesque narrative. Convention dictates that messages should be listed in order of their timestamps, but Apple sometimes rules. Instead, I'll sometimes find

my Apple Watch buzzing about a message that never actually appears on the Mac. I'll reply, and the message I've just responded to will sheepishly appear underneath my answer. It would be comical if this bug hadn't persisted since the very first version of Messages. As it is, it's quite the opposite of funny.

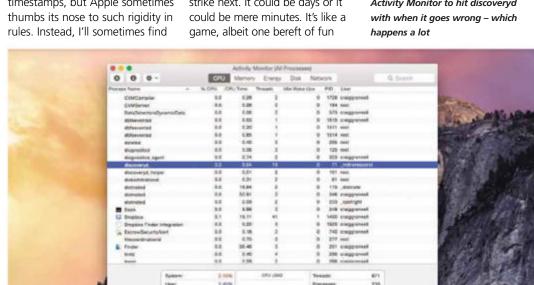
Similarly irritating is the bafflingly awful piece of garbage that is 'discoveryd'. This little gem is responsible for a large part of Mac networking, and it's in fact not so much a gem as a fistful of dung. It frequently screws up DNS name resolution, often uses insane amounts of CPU and messes up getting Apple devices back onto a network when they wake from sleep, resulting in duplicate names. Communication between kit then becomes a big problem.

The fix for the latter issue and sometimes the former is to guit and restart. In fact, with discoveryd, you have to quit and restart everything - only a total reboot of networking kit and the affected items will solve the problem – and then you have the joy of anticipating when it will strike next. It could be days or it game, albeit one bereft of fun

and entertainment, and where you wish you could play literally any other game (well, perhaps aside from 'see how long you can survive in this small pool of ravenous sharks' – although it's a close-run thing).

Quite how Apple allowed itself to get into this position is unclear. Most commentators suspect the cause is the company's relentless schedule. In forcing iOS and OS X alike to get a major update every year, we too often see only a few major bugs squashed before silence ensues for months, while engineers are presumably busy beavering away on what will become the next big thing. But when your messages have been showing up out of order for years or you're again looking at a Finder sidebar showing Apple TV (2), Apple TV (3), Mac Mini (47), Mac Mini (WHEN WILL IT END?), you start to wonder when Apple will get the message and recognise that the goodwill it's banked over the years isn't infinite – and in fact is starting to look a little scarce.

 ➤ We wish there was a hammer in Activity Monitor to hit discoveryd





Craig Grannell is a writer, designer, occasional musician and permanent loudmouth. He's owned Macs since 1996, when Apple was facing certain doom, and is therefore pleasantly surprised by its current success. Find Craig on Twitter at **Gcraiggrannell** 



lan is a professional IT analyst, a semiprofessional writer and a pretty amateur electronic musician. He likes gadgetry and loves making gadgets do things they were never designed to do

# **Get Lost In An App**

Ian McGurren looks at some of the most interesting interactive media on tablets

ooks are book and apps are apps and never the twain shall meet. That's the commonly accepted idea, where books - ebooks included - are fine to carry on their successful formula of pages of text and occasional illustration. Don't fix what isn't broken. But there are increasingly more examples of where the app and the book are beginning to merge, sometimes into something more exciting than even the sum of its parts.

Unsurprisingly, some of those most receptive to this amalgamation of media is young children, having likely grown

It's not all for kids, though, as those kids soon grow up, and with their growth come new, more interesting and exciting apps for them to get their teeth into:

Journeys of Invention, from the Science Museum, is arguably the modern equivalent of the encyclopaedias of the past that many of us stared wide-eyed at as kids. Here, though, instead of the static pages, there are detailed animations, and instead of just reading about them, you get to interact with the exhibits themselves, albeit virtually. It's not the cheapest at £7.99, but it's ideal for firing young imaginations.

the USA in the search of a tribe of Native Americans who were said to speak Welsh. Presented as part album, part book, part travelogue, it's received plaudits from all corners for demonstrating just how these different kinds of media can effectively merge.

The Sailor's Dream from Simogo is also another combination, this time of game, storytelling and gorgeous art. Initially confusing to reviewers expecting a game, The Sailor's Dream is more in keeping with PC titles such as Dear Esther, using gaming engines to tell a story interactively. It has its detractors, citing it as too arty and unfocused, but even they agree that the way it tells the story is engaging and beautiful.

There's little doubt books will still be produced 50 years from now, though maybe sold more as PDFs and MOBIs than in print. The medium has many millions of advocates, some of whom do not want to have their stories told interactively. But, as these apps show, interactive storytelling is growing into something of its own experience, and there are those quite sure that, in time, it will have its own Catcher in The Rye or A Tale of Two Cities. Finnegan's Wake could even make sense!

#### There's little doubt

books will still be produced

50 years from now



up with tablets more than the printed word. There are a plethora of exciting titles for them, from stories to factual:

On the Night You Were Born is a typical child's bedtime story, but with the iPad the story can be easily personalised for your child by way of their name, recorded speech and images. Beautifully illustrated, it's a great way to make a story more personal and memorable for the child.

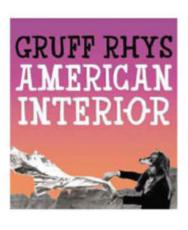
**CBeebies Storytime features** a ton of interactive stories from children's favourite CBeebies stars, all presented in a gorgeous pop-up book style. Charlie & Lola, Peter Rabbit, Something Special and more are all there, with the ability to have the story read to the child or for them to read it themselves when confident. Best of all, being BBC, it's all totally free.

Or how about something less factual but just as exciting? The Adventures of Sherlock Holmes for the iPad is, as one might deduce from the title, an app focused on Britain's best-known detective. Here it's five of Conan-Doyle's titles, with interactive elements that embellish the story. As they're essentially the stories in text form, it's one for the older children, who are happy to read long stories but brought to life with animation and interactivity.

More mature readers users are also benefitting from this new kind of storytelling, though, and not just with straightforward interactive books:

American Interior is an interactive version of ex Super Furry Animals lead singer Gruff Rhys' latest opus – the true story of John Evans, a 18th century Welsh farmer who travelled to





# **Core Blimey**

Intel's latest server-class CPUs have Andrew Unsworth looking to the future of consumer computing

y love of the supremely powerful and supremely expensive Intel Core i7-5960X has long been on record, and if you're a computer enthusiast it's difficult not to love it. However, the Core i7-5960X isn't just desirable because it's the most powerful consumer chip Intel currently produces or because it's the chip that few ordinary consumers can justify buying. It's also Intel's flagship Haswell-E chip, which heralded a new enthusiast-level platform with high-end, highperformance components such as DDR4 RAM. On top of that, it wasn't just more powerful than the outgoing Core i7-4960X because it had two more cores; in my tests, I found that the Core i7-5960X was more powerful than the Core i7-4960X core for core.

You'll therefore understand why my Fozzie Bear socks were blown completely off my feet at news of the Intel Xeon E7 v3 series of enterprise-class chips, the flagship of which has not eight or even 10, but a whopping 18 cores of electrontrafficking power. Of course, the Xeon E7 v3 chips are not designed for consumers, and it's likely that precious few of us mere mortals will get to see one in the wild.

Indeed, the Xeon E7-8800 and 4800 series CPUs are designed for large enterprises such as banks and financial institutions, where having a vast amount of data resident in memory, and having that data crunched and analysed, is of vital importance. The most exciting chip in the series, purely going off specs, is the 18-core Xeon E7-8880 v3, and I'm sure it'll be well suited to the task of managing massive amounts of data. Like the outgoing E7 v2 series chips, this CPU can handle up to 1.5TBs of random access memory.

v2s' 37.5MB. The high-end Xeon E7-8880 has a stock clock speed of 2.3GHz and a boost clock speed of 3.1GHz, which is sensible for such a tightly packed die.

Intel's army of Xeon E7-8800 V3s is destined for the high-end servers of the world, but that doesn't mean we can't rejoice at its birth, because what works at the top end of the market eventually trickles down to the lower end. It doesn't seem that long ago, even though it was, that we were marvelling at four- and six-core serverclass CPUs, and now six- and



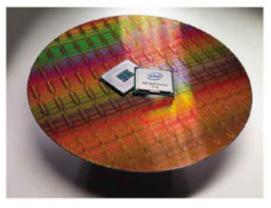
Andrew Unsworth has been writing about technology for several years, he's handy with a spanner, and his handshaking skills are second to none

What works at the top end of the market eventually trickles down

To put that in perspective, the Core i7-5960X can 'only' handle up to 64GBs of RAM, and unless you're cutting a Hollywood blockbuster on your X99-based workstation, you're unlikely to need all that 64GB. However, the new v3 chips have more cache memory, with high-end v3 chips having 45MB compared to high-end

eight-core CPUs are no longer excessively extravagant thanks to chips such as AMD's FX and Intel's Core i7 chips. I'm sure it won't be long before eightcore chips are seen as boring, pedestrian and ordinary, and it's 12-core chips that are within credit card distance of bringing consumer-based joy and happiness to PC devotees.





## Specialists



Ryan Lambie has loved videogames since he first stared up in awe at a *Galaxian* arcade cabinet in his local chip shop. 28 years on, Ryan writes about gaming for Micro Mart. He's still addicted to chips and still useless at *Galaxian* 





# This week, **Ryan** takes an early look at Assassin's Creed: Syndicate, and checks out Blizzard's hardline approach to cheats in World Of Warcraft...

#### **Plug & Play**

Victorian London always seemed like a natural time and setting for the time-hopping Assassin's Creed franchise, even if Ubisoft once dismissed the notion as "too obvious". In recent months, rumours that the latest instalment in the long-running sandbox franchise was indeed heading to Britain's capital in the 19th century have grown increasingly persistent. A name even leaked: Assassin's Creed: Victory.

Well, the rumours were true, even if the name wasn't quite on the mark. On the 12th May, the latest chapter got its grand unveiling, as Ubisoft Quebec showed off the first gameplay trailer and plot details for Assassin's Creed: Syndicate. Set in the year 1868, it introduces two new protagonists brother and sister Jacob and Evie Frye, whose aim is to build up their own syndicate among London's criminal underground, and use them to overthrow the Templar Chapter that has a stranglehold on power. All the things you'd expect from a Victorian Assassin's Creed are present and correct. Cobbled streets? Check. Lots of hats and bustling, five-foot wide dresses? Check. Gaslight? Check. Horsedrawn carriages? You betcha.

In fact, Syndicate will bring a few new mechanics to the now familiar platforming-and-murder mix. In a twist borrowed from the *Grand Theft Auto* series, you'll now be able to boot an unsuspecting driver from his mount and steel his carriage; one of the most rousing moments in Syndicate's gameplay trailer shows the player belting down London streets in a carriage, the horses galloping frantically on the grimy cobblestones.

The sequel also throws in a grappling hook – akin to the ones you might have fiddled with in games like *Batman*: *Arkham Asylum* or *Bionic Commando* – which allow the player to reach high places in satisyingly short order. And if there's one thing the heroes in the *Assassin's Creed* series love more than just about anything, it's skulking about on rooftops.

Stealth and combat have reportedly been given an overhaul, too, with a new system which allows for more fluid movement while sneaking around, while Jacob (or Evie, if you choose her) have been given a new arsenal of weapons which include knuckledusters and hallucinogenic darts – the idea, Ubisoft says, is to bring a greater amount of hand-to-

hand combat to *Syndicate*, with some missions ending in goreladen mass brawls.

It all sounds promising, but when it comes to the Assassin's Creed franchise, there's an almighty elephant in the room: last year's Unity. An infamously botched release, Unity was riddled with bugs and mechanical problems; an-oft shared image was of a ghoulish character composed of nothing more than a set of grinning teeth and staring eyes — all because his flesh texture hadn't loaded up.

"The worst thing that can happen actually when you release a game is to have one of your bugs becoming the front cover of the entire internet," a developer said in a video expressly designed as an apology for *Unity*. "Nobody's happy when four years' of hard work is just imaged with a bug."

Ubisoft says it's learned some valuable lessons from *Unity*, the lowest-scoring entry in the franchise so far. If that's the case, then *Assassin's Creed: Syndicate* has the chance to restore the series' reputation, and maybe even revitalise what has become a somewhat staid formula.

Assassin's Creed: Syndicate is out this winter.









▲ Remember kids: don't use bots. A reported 100,000 players have been banned for using automated programs in World Of Warcraft

#### **Online**

Even as rumours begin to circulate that NCSoft's glossy MMO Wildstar is about to switch from subscriptions to free-to-play, World Of Warcraft continues to hold onto a devoted core user base. Sure, its numbers have dwindled considerably in recent months, but at around seven million accounts, Warcraft remains the biggest subscription-based MMO in the planet.

In fact, Warcraft's lead designer Ion Hazzikostas remains confident that the estimated three million players that the game lost in the space of a month. The players' departure, Hazzikostas says, is "cyclical" — a result of them losing interest after an initial spike of excitement following the expansion, Warlords Of Draenor.

"Players aren't necessarily viewing World of Warcraft as

a year-round lifestyle so much as a game that they love," Hazzikostas told *VentureBeat*, "where they're going to check in, see what we've got, play the content in a patch, go off, play some other great game that just came out, and then come back when we have something new to offer them. And to some extent, that's okay. We don't want to prevent people from enjoying the game that way."

Meanwhile, Blizzard has said that it's banned "a large number" of Warcraft accounts in an effort to stamp out bots. Although Blizzard hasn't officially confirmed the number, it's thought that it could be as high as 100,000.

Blizzard, it seems, has brought in a new system that detects who's been using bots like Honorbuddy – a piece of software allowing players to automate repetitive tasks like grinding and resource gathering. The number of bans seems to have been so drastic that Bossland, the maker of Honorbuddy, has decided to withdraw the bot from the web.

"It seems like Honorbuddy was detected, we are not sure, but looking at the ban threads, we think that it's the most likely option at the moment, "Bossland wrote in a statement. "We are sorry for all your lost WOW Accounts, hopefully you can use them again after the six month ban is lifted."

For its part, Blizzard has stated it will ban any player using bots — even casual players who use programs to do things like automate crafting. "If a program is pressing keys for you," Warcraft's community manager said on Twitter, "you've violated the [Terms of Use]." You have been warned.

#### **Incoming (Or Not)**

While Assassin's Creed remains one of Ubisoft's flagship franchises, The Division could join it as the start of a popular new series. Set in a near-future America riven by a pandemic, you take control of an agent charged with maintaining order and containing the disease while avoiding infection or death by angry mob yourself. An openworld game of shooting, stealth and group missions, it looks like one of Ubisoft's most ambitious projects in years, with no fewer than four studios working on its creation. The downside? All that ambition seems to be resulting in delays. Originally scheduled for 2014, The Division was pushed back to 2015, and has now been bumped once again Ubisoft's disease-control epic is now set for launch in the first quarter of 2016. Let's hope it's worth the wait.







▲ Ubisoft's eagerly anticipated disease-control simulator The Division has been delayed once again — it's now scheduled for release in the first quarter of next year

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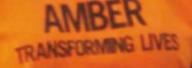


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Please try to keep your queries brief and limit them to just one question per letter, simply so we can squeeze in as many as we can each week. Please include relevant technical information too.



#### A What Spot?

As a total newbie when it comes to PC technology and mobile phones, I have what I think is going to be a really easy question for you. Basically, I have a laptop, and in the area I live we often have power cuts and other issues that mean Internet can be less than reliable. This is a problem, as I need to use the Internet almost every day.

When I'm left with no Internet connection, I'm at a loss, and have to rely upon my phone (an iPhone 4) for all of my email and browsing. This is useful, but it's hard to do many things on such a small screen without a full keyboard, so it's use only extends so far.

I have heard, however, that I can use my phone and attach it to my laptop so I can access the Interent as normal, which is something that sounds like it could be a very good feature, and one that could be very useful to me in these instances. The problem I have, is that I just don't know how to do this, and I'm also not sure if it's a good idea, as I don't want to run out of data on my phone.

In short, I need some advice from a professional. How can I actually do this with my hone and laptop, and should I even try? Will is use too much data? I look forward to reading your response in this fine magazine. Keep up the good work.

Mel

Most mobile phones can be used as a mobile hotspot these days, and it's one of the most useful functions for those who travel a lot, and can't always guarantee they'll have access to a decent connection. This functionality extends to the iPhone 4 too, and using one with your computer is easy.

To set this up, go into your iPhone's Settings and look for the Personal Hotspot section. Here you'll be able to set up your own personal hotspot and activate it. To do so you'll need to give the hotspot a name, and you'll also need to specify a

password. Ensure your iPhone's wi-fi is operating, as well as your laptop, and you'll be able to locate and connect to the iPhone, which will then act as an Internet hotspot, granting you access to the Internet.

Using your phone as a hotspot can be a huge help, letting you get online when all else fails. However, it's not the most economical or flexible option. Data plans for mobile phones are nowhere near as generous as normal home broadband packages. Whereas many home broadband deals offer 200-300GB, or even unlimited use per month, mobile data plans offer a tiny fraction of this, often around 5GB. This means it won't take very long at all to max this out if you're not careful.

If you simply need to do some light browsing, or check email, this option is fine, and you shouldn't have too many issues. Streaming video, downloading data, and even browsing more intensive sites filled with images, animations, or embedded video can take its toll. Doing this will quickly eat away at your monthly data use, and you'll soon end up with extra charges on top of your contract.

If you do make use of your phone's data, always keep a close eye on your use, maybe using your provider's own mobile app to monitor phone use. Steer clear of heavy use, such as streaming video, and keep social networking to a minimum, as Facebook feeds can take up a surprising amount of data, with images, embedded videos and so on filling up your feed.

**∀** It's easy to turn your iPhone into a personal hotspot

•••• vodafone AU 3G 15:16



Settings Personal Hotspot

#### Personal Hotspot



Turn on Personal Hotspot to share your iPhone's Internet connection. Additional usage charges may apply.

#### Wi-Fi Password





#### TO CONNECT USING WI-FI

- 1 Choose "Airs" from the Wi-Fi settings on your computer or other device.
- 2 Enter the password when prompted.



#### TO CONNECT USING BLUETOOTH

- 1 Pair iPhone with your computer.
- 2 On iPhone, tap Pair or enter the code displayed on your computer.



#### MP3 Veteran

I've not used my home PC for quite some time, several years give or take. To give you some idea, when I last used my PC, I was making use of a cool little music program call Winamp, and I used to use ICQ to talk to friends online. There was no Facebook, Twitter, or Instagram, and my browser of choice was Netscape Navigator. The reason for this lack of use is travel. I've spent a long time working abroad, with a lot of travel, so didn't really have time to use anything other than my phone and, eventually, a tablet.

Now I've returned to the UK to settle down, and I wanted to make use of my PC (a cheap, new one, not the vastly out of date older model), with one of my major use being to play music, as I have an excellent PC speaker set that I kept from my old PC that still sounds superb.

I went online to grab my trusty Winamp, and found that it's far from the program I remember, now owned by AOL of all people. This isn't good, and I find it to be a cluttered and overcomplicated mess. What I need is a good MP3 player that can manage my MP3 collections (which is thousands of tracks). Extra features would be welcome, but not if they make the program a pain to use.

It should also be free, as I really can't justify paying for an MP3 player when there are so many free options that have done the rounds. Thanks for your help.

Jez

I do, indeed, remember the likes of the original Nullsoft Winamp and programs like ICQ. Winamp was the premier MP3 player of its day, until AOL bought it, and many users either kept the old versions, or moved to other programs. Since then, AOL has actually sold the program to new owner, Radionomy, but this hasn't helped the program in the eyes of many. The new company is even selling Winamp 2 as a freemium title should you be even vaguely tempted.

Clearly, you're not alone, and there are many more MP3 Players around today, some good, some bad, and a few that I'd argue are even better in some ways than Winamp – even in its halcyon days. One such tool I consider to be one of the best is MusicBee (getmusicbee.com).

**66** Winamp was the premier

MP3 player of its day, until

AOL bought it 99

This is totally free MP3 player and management app that also contains a whole heap of extra features. These features don't get in the way of the core music playing and managing, making it a perfect option for you.

It can easily manage and catalogue all of your MP3s, supports playlists, tagging (auto and manual), lyric display, CD ripping and burning, file conversion, and more. It's a great program, and one that I highly recommend.

**▼** MusicBee is one of the best free music applications around, and packs in a ton of features





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D'Allison, a veteran
of Micro Mart's panel
of experts. He's here
to help with any
technical questions,
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Contact Jason by email at: jason@micromart.co.uk

While we try to cover as many questions as we can, we regret that Jason cannot answer your questions personally, but he'll cover as many as he possibly can each week. Please ask one question per letter and remember to include the full specification of your computer, including its operating system.

Jason

#### **The Smart Choice**

For the last five years my phone's been an LG Viewty Snap GM360. It's served me well, but obviously it's getting old. I do like many of the features – in particular, the calender, camera and radio – and because of this I'm tempted to buy another, similar LG. However, I'm also tempted to look elsewhere, and I'd maybe consider a smartphone (apparently my LG isn't one).

What would suit my needs? The GM360 isn't too good for social networking, nor for the internet in general, and the touchscreen's difficult to use without a stylus. I'd like any new phone to be better in these areas. I don't want to lose the LG's user-friendliness, though, and I need something that'll fit easily into my pocket.

I'm put off Apple's phones because of the screen fragility, and I hear HTC phones can be hard to use. I like what I've seen of Samsung's Galaxy range, but is it wise to jump to another brand? I'd appreciate any advice you can offer.

#### Perry George, Yandex

Your LG GM360 is a feature phone. That is, its functionality is pretty much set in stone. There's very limited scope for updating the OS or adding new apps. Smartphones, in every sense, are fullmonty computers. Their operating systems can be updated and often completely changed, and apps – from a choice of tens or even hundreds of thousands – can be added and deleted at will.

Entry-level smartphones are now so cheap, no one should be buying a feature phone. I'll accept no argument on that, Perry! For starters, the touchscreens on many feature phones, including your LG, are resistive – they require pressure to register an input. No wonder you want something better. The screens on modern smartphones are capacitive – they work solely by the electrical charge in your fingers.

Basically, even if you never tap into its full potential, a smartphone will be faster and more pleasurable to use. But you \*will\* end up tapping into its full potential. Dying of hunger in a strange town and want to find a McDonald's? Fire up the GPS and Google Maps. Been for a jog and need to check your pulse? Download a heart-rate app and place your finger over the camera. In Asda and want to know if Call of Duty: Same as the Last One (Unlimited Edition) is cheaper elsewhere? Scan the barcode into a price-comparison app. You know it makes sense.

Now, LG makes some fine smartphones, but don't buy one solely in the hope you'll be familiar with the way it operates. All smartphone OSs – most LGs run Android – work quite a bit differently to the proprietary OS on your GM360. You'll have the same learning to do regardless of which brand you plump for. Not much, mind – it's all dead easy. Oh, and HTCs are no harder than any other brand.

Regarding the calendar, Android has Google's Calendar, Windows Phone has Microsoft's

Calendar, BlackBerry has, well, BlackBerry's Calendar, and iOS has, er, Apple's Calendar. Imaginative names, huh? If you don't like what's supplied by default, there are dozens of alternatives, most of them free.

The camera on the your old LG is actually fairly reasonable. A 5MP sensor, auto-focus, and an LED flash – some newer low-end smartphones fall short of that. Spend more than about £60, though, Perry, and you'll usually be in a different world. And videos recorded on the GM360 make Laurel and Hardy shorts look as though they were shot in Ultra HD.

If you really do need an FM radio, bear in mind that many smartphones don't now have one. Be careful – check the specs. The trend these days is to use web radio, which just requires a wi-fi or 3G/4G internet connection (your GM360 supports neither).

As for screen size, bigger is better. Typing is so much easier on a bigger screen, and watching videos, surfing the web and playing games on a tiny screen is nearly as painful as childbirth. In my view, 4.5" is as about as small as you should go, and you may be surprised at just how big a phone can be before you lose pocketability. Your best bet is to pop into some shops to see which phones feel comfortable. Just be careful if you give any the pocket test – you don't want to get arrested.

I wouldn't worry too much about screen fragility. All smartphone screens are fragile to a degree, usually because they're fronted by a sheet of glass. For some reason, iPhones do seem to come off worst, but not to the point I'd recommend not buying one. It's probably more to do with their metal frames (many other phones use plastic) than anything else.

Recommending any specific models is difficult, because I don't know your budget. I'd also need to know what features you absolutely can't live without and whether console-level gaming's on the

cards. Maybe you could sign up at forum. micromart.co.uk and ask for advice there. A decent all-rounder, though, is the new Motorola Moto E (second-generation). The 4G version can be bagged for just £99.

> These days, you'd need to be a couple of pixels short of 1080p to buy a feature phone





#### Not Known At This Address

My wife has a Gmail account. She signed up, though, when it was Google Mail, and that might be the problem. You see, she's started receiving another person's emails – lots of stuff about accounts she doesn't have and people in the US with the same surname. I've searched online and Google says that when people 'own' a googlemail.com address, they also 'own' the equivalent gmail.com address, yet it seems here that someone else has managed to register it. Google says this is impossible, but my wife's problem doesn't appear to be unique. What's your view?

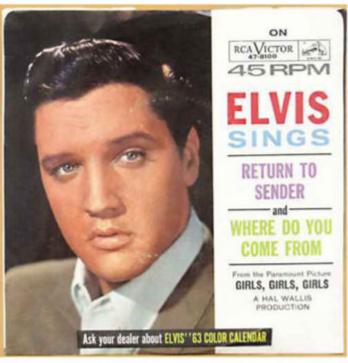
#### Francis Kinsler, Gmail

It's always been Gmail, Francis. Between 2005 and 2010 (the service launched in 2004), a trademark dispute meant that in the UK (and possibly Germany) Google was forced to change the name to Google Mail. Once that dispute was settled, the name reverted to Gmail. It was always Gmail everywhere else.

It's true that when someone signed up for a googlemail.com address, the equivalent gmail.com address was automatically reserved (incidentally, googlemail.com addresses can no longer be created). Therefore, it is indeed impossible for someone else to register it. Your wife can use either variant – they're effectively the same thing.

Almost certainly someone has created a Gmail account with a very similar name to your wife's and then typed it in wrongly when signing up to various websites. Probably a single character was missed off or added, turning the address into your wife's. No doubt this person has scratched away a good deal of hair in wondering why expected emails aren't coming through!

What can you do? Well, you could reply to the emails and explain that you're not the intended recipient – use the



▲ Are you receiving someone else's email?

explanation I've given above. Be firm – in effect, the emails are spam. You could also try to identify who the intended recipient actually is – look on Facebook and so on and send a message. You might be surprised at how easy it is to track someone down. Other than that, Francis, I fear your wife will just have to live with the problem until the emails dry up. Sorry.

#### The View From Here

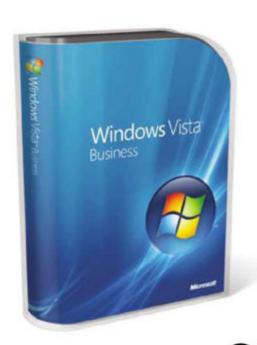
My trusty Toshiba Satellite Pro U400-246 laptop is about seven years old and the hard drive has just failed. A work colleague is sorting this out for me but he's also said that Windows Vista, the original operating system (there's a valid sticker on the base), is now an online security risk. Apparently I need to upgrade to Windows 7 (I don't think the laptop is capable of running Windows 8.x). What's the cheapest way to acquire this? It seems a new copy is about £70.

#### J. Rose, South Yorkshire

You've been misinformed, my friend. It's true that these days Windows XP shouldn't go within 100 yards of the Internet (unless the host machine isn't on a network and there's no data or credentials you're bothered about losing), but the same is definitely not true of Vista.

Vista may well be an OS Microsoft would prefer to forget, but under the extended-support programme, the company has pledged to keep it updated and free from gaping security holes right up till 11th April, 2017. Vista came in for some stick when it launched (mostly justified), but when fully updated and given suitable hardware – your U400-246's default Core 2 Duo P8700 CPU and 3GB of RAM are ample – there's nothing wrong with it. Windows 7 would give you virtually no benefit. Save your money!

➤ Is Windows Vista the devil in disguise?



# Crowdfunding Corner

This week, conversion: converting your wired headphones to wireless, and your slow USB charge port to a fast USB charge point. All thanks to crowdfunding projects you can support!

#### Spiro X1

We've covered wireless headphones a lot in this column, but wireless headphones aren't necessarily within reach of all consumers. They are, after all, usually quite expensive, and spending £80-£150 on a single pair of headphones seems a little crazy when you consider that they might break or fail. And what's more, you might have just spent that much on a new pair already.

Therefore, the Spiro X1 makes a decent alternative to wireless headphones: it's a wireless headphone adaptor, built to convert any pair of standard headphones into a pair of Bluetooth headphones, as long as they have a detachable 3.5mm audio wire, as most high-end headphones do. An LED halo gives you simple feedback on the connection status and charge, and built-in controls allow you to send commands to any paired Bluetooth device.

Early bird tiers are running out fast, but all backers pay just \$50 (£32) for the Spiro X1 unit in black or white, and while it only ships to US and Canadian addresses, there are services you can use that will provide you a US shipping address and then send it over. The goal is quite far away: at time of writing it's raised \$4,000 of \$75,000, but there are still weeks to go until the campaign has finished. We're relatively sure this one's getting made.

URL: kck.st/1R3nUEt

Funding Ends: Wednesday, 17th June 2015

#### **USB Chargedoubler**

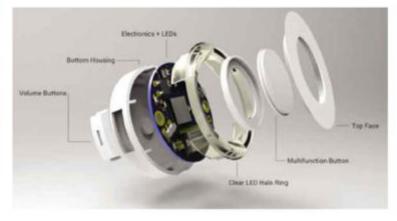
It's rare we look at IndieGoGo projects, simply because Kickstarter is the bigger site, but this project caught our eye: the USB Chargedoubler. In an age when most phones won't last 24 hours without a charge, having the ability to juice your batteries up faster than ever isn't something to be sniffed at. This gadget provides a full 1,000mA charge instead of the 500mA charge most USB cables offer.

The USB Chargedoubler doesn't just provide a charge at double the speed of a normal USB cable, though that is the primary purpose. It also has a magnetic design intended to fit on a normal keyring so you're never without your custom charger. It's compatible with Apple, Android and Windows devices. The 'Data Protected Charging' capability also ensures that the cable isolates your phone from the system it's plugged into to ensure the safety of your device and data.

The cable can be bought in both micro-USB and Lightning-compatible models, in a variety of different colours. It can even be bought with compatibly for the new USB-C standard! Worldwide delivery is estimated for August, and the \$14,000 funding target should have been met by the time you read this. You can get a Chargedoubler for as little as \$12 (£7.70), but beware: that price doesn't include shipping insurance or tracking. If you want one, we'd advise paying for the \$15 (£9.60) tier instead!

URL: bit.ly/1Hhn5AQ

Funding Ends: Sunday, 7th June 2015





Disclaimer: Images shown may be prototypes and Micro Mart does not formally endorse or guarantee any of the projects listed. Back them at your own risk!



# App Of The Week Salient Eye

#### **David Hayward** gets security conscious this week

was reading recently about various projects for old smartphones and tablets, the ones that now have a lesser version of Android installed and are no longer able to keep up with the demands a modern app asks from them.

There are a great number of uses an older phone or tablet has, but one that caught my imagination was to turn the now defunct device into a home security platform using a collection of apps.

The apps themselves varied, but most ran to using the phone or tablet's camera as a kind of IP webcam. One in particular seemed to be a little more useful than the rest and even featured motion detection, still pictures, email alerts and an audible alarm.

#### Salient Eye

Salient Eye is remarkably simple to use, but it's quite an effective security alarm system. It's free to install and use, and once you have the app on your desired device, all you need to do is set the volume as high as possible, enter a security arm and disarm code, place the phone or tablet in a location that it'll monitor and leave it alone for 30 seconds.

Once the 3- seconds has counted down, you'll get a three-second beep before the app is 'armed' and monitoring the image in front of the camera. Now, should anything move

within sight of the camera, the app will emit a high-pitched klaxon, red alert alarm.

The alarm will continue to sound until you re-enter the disarm code, and you re-establish the connection and monitoring again. With luck, whatever triggered the motion detection will be caught red-handed.

There are also a number of interesting features you can set up within Salient Eye. For example, you adjust the sensitivity of the motion detection, alter the detection cooldown alarm time, block the Home button from working, set up an email account to send alerts to and even warn you of network loss or low power.

Furthermore, you'll be able to control the armed device remotely using the remote control app for Salient Eye and by creating a Salient Eye account through which to manage the device. And the device you're using doesn't even require a SIM card present, as it can send alerts via wi-fi to the specified e-mail address.

It's an interesting security app, and if you're anything like us, then you'll already have a few smart devices dotted around your home or laid to rest in a drawer alongside keys for old locks and takeaway menus. If you're security conscious or just want to set up something to monitor the nocturnal activities of pets, this could well be the app for you.

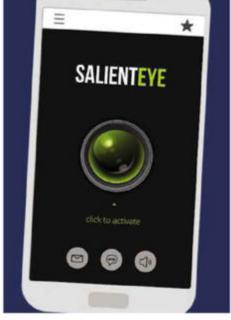
#### Conclusion

We found Salient Eye to be an excellent alternative to the hassle of setting up something more elaborate, like the Raspberry Pi security and motion detection camera we worked on some months ago.

The motion detection in Salient Eye is excellent, and its features are useful and work to near perfection. If it's peace of mind you're looking for, then we think Salient Eye is the only app you'll need to install. You can find more details on its Google Play page at **goo. gl/vzqPbU**.

#### Features At A Glance

- Free.
- Excellent motion detection.
- Captures images.
- Sound an alarm and send you alerts.



▲ Salient Eye is an excellent motion detection app, with a wealth of features



▲ Turn your old phone or tablet into a smart security device

# Logging Office of that that the state of the

t both its Build conference and Ignite event, Microsoft has signalled a number of significant changes that will accompany the next version of Windows.

The headline grabbing bit was that from this point onwards it won't be having big number version releases, but instead the product will morph continually through a continuous improvement program. That sounds interesting, but it also has the

potential to really mess things up if it makes changes people don't like, as it did with Windows 8.

But what's really got people nervous is also the idea that instead of the predictable delivery of updates as per 'patch Tuesday', patches will arrive when they're 'ready', and many will be installed regardless of the PC owner's wishes.

Given its track record for releasing broken code, this has all the hallmarks of someone with inherently sweaty palms diverging into professional chainsaw juggling.

If you think I've been unkind to Microsoft, and I have on occasion been that, the usual defence that is put forward is that given the almost infinite variance of PC hardware, it's amazing that Windows runs at all.

Yes, it's true it does have a very flexible architecture to support, and in that respect it is almost impossible to foresee every eventuality. However, it's released duff and potentially device bricking patches on the Surface tablets and Lumia phones – i.e. hardware it actually designed. If it can't actually get those very specific updates right, then what's the hope for the rest of us?

I can't help be admire its confidence, though it peaks my curiosity that it has so much, with its track record. The only conclusion that can be drawn is that many of its current development engineers are so young that they don't recall some of the utter clankers that they've pushed out, then recalled in full-on emergency mode.

Unless it has some magical new internal means of testing patches that borders on artificial intelligence, then moving to a more aggressive update schedule could be a disaster just waiting to happen.

What's fascinating is that at least some parts of the company realise this, and there is much talk about how enterprise customers will be able to control the updates more than conventional users.

This is a critical admission, because it accepts that business customers like stable unchanging platforms, and the potential for a rogue

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piece of code to have unpleasant consequences. But (and

this is the part that doesn't have a rational story yet) how does that work in the bigger context of 'one Windows'?

The free update from Windows 7 and 8 is meant to pool the vast number of Windows users on the same release, in a way that they haven't really been since Windows 3.x was launched. But if businesses have a get-out clause, that breaks those ambitions from the very outset.

However this works out, Microsoft looks intent on forcing itself to provide the level of service it's often marketed but never previously managed to come close to.

One part of me wants to salute its ambitions, and another part is watching through my fingers in morbid fascination as to what happens next.

Windows 10 is a major departure for Microsoft, so much that it really needs the company to reinvent not only its most important product but also itself.

## Mark Pickavance

#### LAST WEEK'S CROSSWORD

Across: 1 TIFF, 3 Whizz-Kid, 9 Modicum, 10 Erode, 11 Coronagraphs, 13 Dynamo, 15 Leeway, 17 Vulture Funds, 20 Aurai, 21 Hacking, 22 Handsome, 23 Heat.

Down: 1 Timecode, 2 Fader, 4 Homage, 5 Zeeman Effect, 6 Knowhow, 7 Dies, 8 Econometrics, 12 Eyesight, 14 Neutron, 16 Graham, 18 Naive, 19 Path.

#### DISCLAIMER

The views expressed by contributors are not necessarily those of the publishers. Every care is taken to ensure that the contents of the magazine are accurate but the publishers cannot accept responsibility for errors. While reasonable care is taken when accepting advertisements, the publishers cannot accept any responsibility for any resulting unsatisfactory transactions. As we write this, we've just eaten a whole sixpack of mini Danish pastries, and we're feeling pretty happy about it, especially because it gives us something else to focus on other than the weird weather we've been having. One moment it's sunny, the next it's rainy. And we just happen to have a camping trip organised for the

weekend, so we've been obsessively looking at weather apps on our smartphone to see what the forecasts say. So far, we've come to only one definite conclusion: none of them have any idea at all what the weather is going to be like. Some sources say lots of sunshine all weekend, others predict only rain, while some say it will be mixture. Just to be safe, we're packing our raincoats, as well as our flipflops and sunglasses. Call us pessimists if you like, though, but we don't think there's much chance of us getting a suntan this weekend. Whatever happens, though, we're determined to enjoy our time in the great outdoors (a field somewhere in Surrey), even if means we don't get any more pastries for a couple of days.

#### THIS WEEK'S CROSSWORD

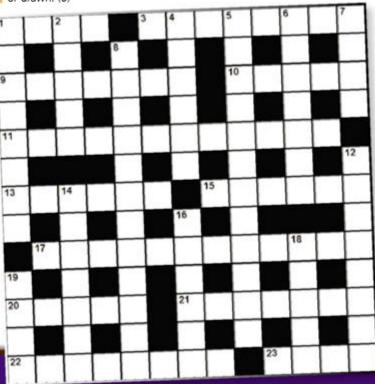
#### Across

- 1 Denoting a factor of 10-9. (4)
- 3 Produce or fill with a deep, full, reverberating sound. (8)
- 9 Positive movements or trends in business activity (7)
- **10** Node.JS Connect module for this domain redirection. (2-3)
- **11** Those who watch examination candidates to prevent cheating. (12)
- 13 Of or relating to bears. (6)
- **15** A dwarfed ornamental tree or shrub grown in a tray or shallow pot. (6)
- 17 Each of several possible ways in which a set or number of things can be ordered or arranged. (12)
- 20 Enter data into a computer. (5)
- **21** Withdraw a rope or hawser from a securing ring or block. (7)
- **22** A trivial lie. (5-3)
- 23 A meson involved in holding the nucleus together; produced as the result of high-energy particle collision. (4)

#### Down

- 1 The first nuclear-powered submarine, launched in the USA in 1954. (8)
- 2 The digital distribution of television content via the Internet. (3,2)
- 4 Wooden frames for holding an artist's work while it is being painted or drawn. (6)

- 5 Machines designed to achieve flight by means of flapping wings. (12)
- 6 Google's no visit, no fee online advertising product for businesses. (7)
- **7** King of the English, the eldest son of King Edmund I and Aelfgifu, and succeeded his uncle King Edred in 955. (4)
- 8 The branch of mathematics dealing with the relations of the sides and angles of triangles and with the relevant functions of any angles. (12)
- **12** German-born American theoretical physicist, founder of the special and general theories of relativity. (8)
- **14** A machine used to project the image of a circuit in photolithographic semiconductor fabrication. (7)
- **16** A dormant volcano in the Chubu region of Japan. Rising to 3,776 m. (2,4)
- **18** Marks used in ancient manuscripts to mark a word or passage as spurious, corrupt or doubtful. (5)
- **19** Popular freely distributed cross platform software application for image processing. (4)



# In Next Week's Micro Mart\*

Are technology outlet stores really good value?

How does RAID work, and is it actually worth setting up at home?

How Microsoft is working to crack the quantum conundrum

Plus the usual mix of news, reviews and advice

<sup>\*</sup> May be subject to change

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